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Charles V. Riley,

Washington, D. C.

POISONOUS INSECTS

BY

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POISONOUS INSECTS. In the preparation of this article the author feels called upon, by way of premise, to state that the term "insects" is used in the larger, popular sense, and is, technically speaking, not a very good index to the article itself, which is intended to include those Arthropods which are known to be more or less poisonous, and to affect man and other animals, and not to include the vast number of minute, poisonous creatures which produce abnormal growths upon plants. In order to cover the ground as fully as possible, within the limits required by the editor, a systematic arrangement of the species is adopted, beginning with the lower, and, to avoid detailed descriptions, brief classificatory characters are given.

The question as to the relative virulence or innocuousness of insect poisons is one depending very much upon the susceptibility of the individual poisoned. The effect depends in great measure upon the health and constitution of the individual attacked, and may even depend upon other circumstances—as, for instance, whether the venom has been previously more or less fully expended or exhausted. With most poisonous insects, as with poisonous species among the higher animals, there is usually connected with the bite or sting a poisonous secretion, which may come from distinct poison-glands or from the ordinary salivary glands more or less modified. The secretions of these glands are elaborated by a successive series of epithelial cells that line the interior of these organs. The fluid contained within the cells forms the poisonous secretion. It stands to reason that when this is expended too frequently the fluid is diluted, and its property rendered less active. The poison in Arthropods has not yet been as fully studied as that of the venom of serpents by Dr. J. Weir Mitchell, and others, so that there is great room for careful study and experiment. There is reason to believe, however, that in the more venomous species, as the tarantulas or bird-spiders, and the more poisonous of the Hymenoptera, the nature of the poison is similar to that of snakes, since the consequences, as well as the antidotes, are somewhat similar. The poison in reptiles is an albumen compound, while in the less venomous Arthropods it is some form of acid, the general antidote being some non-poisonous base, like the alkalis—magnesia or lime and their car-

bonates, ammonia, etc. From the more intense poisons we have, in Arthropods, every gradation, and in the majority of cases the effect is simply corrosive. Some cases will be included in the following account, as, for instance, the effect of worms and other larvæ, where there is reason to believe that the result is due purely to mechanical irritation, no poison being secreted, though the creatures are generally accounted poisonous in the popular mind. In all true stinging insects only the female has the power, the sting being, in fact, a modified ovipositor; and in the Diptera, which bite or lance with the mouth, it is the female alone which torments. In those insects which pierce by the beak (mostly among the Hemiptera), on the contrary, both sexes take part.

CLASS ARACHNOIDEA.—Air-breathing Arthropods, with head and thorax united into one solid piece, with mandibles and maxillæ, eight legs and legless abdomen. Members of this class vary greatly in the formation of their bodies. Head and thorax are almost always united in a short cephalo-thorax, but the abdomen is very different in the various orders.

Nearly all Arachnoidea are produced from eggs; a few mites and the scorpions form the exception. The newly hatched young possess mostly the form of the mature individuals. Some mites, however, have only six legs, others only four, when born; but in most instances the other legs appear later with the successive moults.

The great majority of the Arachnoidea feed upon animal matter; only a few subsist from vegetable substances. The larger and more highly organized forms kill their prey—chiefly insects—by means of peculiar organs, situated either on the anterior or the posterior end of their bodies; in most cases they have the power to secrete poison, which renders their bite or sting more effective.

ORDER LINGUATULIDA.—Parasitic Arachnoidea, with a worm-like, transversely wrinkled body and two pairs of jointed hooks near the opening of the mouth, which possesses no mandibles. These animals were for a long time considered true intestinal worms. This worm-like appearance is produced by the very small cephalo-thorax, but chiefly by the enormous increase in length of their abdomen. A similar increase in length takes place in the well-known parasitic mite of the human nose, the *Demodex folliculorum* Linn.

Mature specimens of Linguatulida possess no mouth-organs whatever; the four chitinous, jointed hooks, that can be entirely withdrawn into pockets, are probably the claws of the last two pairs of legs, the two pairs of front legs of the larva having been lost during the moults. Eyes and organs for respiration and circulation of the blood are also lacking; a simple intestinal tube in the centre of the body opens in the posterior anus. Males and females differ greatly in size; the genital organs of the very small male are close to the mouth, those of the female at the posterior end of the body.

Sexual specimens of Linguatulida are found in the air-spaces of vertebrates and amphibia, and were first discovered by Chabert, in 1757, who named them *Tania lanceolata*. Professor R. Leuckart has observed the transformations of *Pentastomum* tanioides*, which occurs in the nasal cavity of dogs, rarely of horses and goats. It is a white or yellowish animal, lancet-shaped, with a flat abdomen, rounded upper-side, and divided into about ninety segments; many stigmata occur along the sides of the abdomen, which measures in the males from eight to ten millimetres, in the female seventy to one hundred and thirty millimetres. The life-history of this animal has been studied by Zenker, Leuckart, Loudon, and others. Zenker discovered the frequent occurrence of this parasite in man.

The embryos, still enclosed in the eggs, find their way with the mucus of the infested animals to plants, and thence to the stomach of rabbits or man. Here they hatch and penetrate to other organs, but chiefly to the liver, where they occasion serious injury. If the host does not succumb, they encyst themselves, undergo sev-

* *Pentastomum*—five mouths, the four claws having been considered erroneously as mouths.

eral metamorphoses, and develop into a toothed *Pentastomum* (*Pentastomum denticulatum*). If they succeed in reaching the flesh of their usual host—the rabbit, the mouth of a dog—then they penetrate at once to the air-passages, where in the course of three months they assume their sexual form.

Dogs infested with this parasite sometimes become perfectly frantic and appear mad. Dr. Loudon reports the case of a man who suffered for seven years with constant bleeding of the nose; the removal of the parasite soon restored his health; he suffered also from the young parasites, which had found their way to his liver. The female parasite is said to deposit as many as five hundred thousand eggs. The bad habit of kissing dogs is again illustrated in the case of this parasitic mite. Dogs should never be allowed to eat the intestines of rabbits, of which they are very fond. Injections of benzine into the nasal

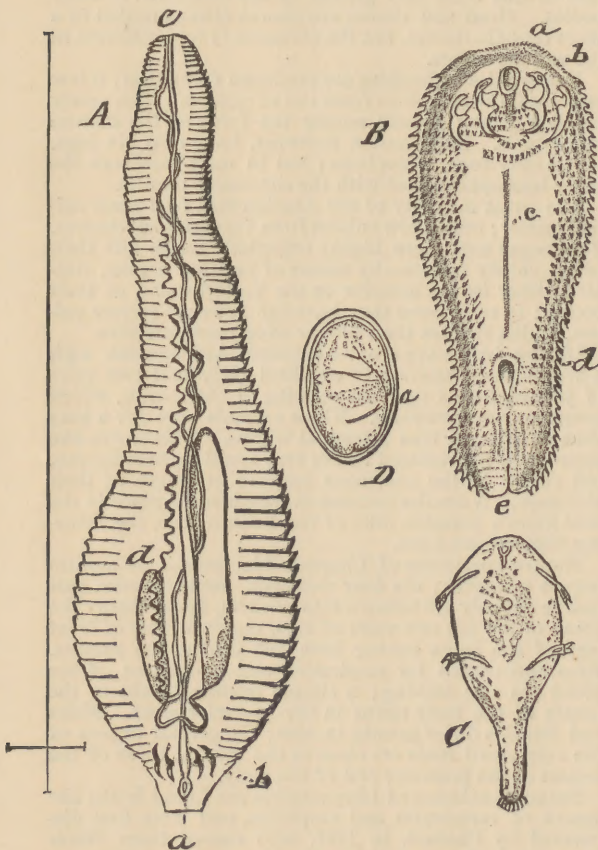


FIG. 2971.*—A, *Pentastomum Teneioides*, Mature Female. a, mouth; b, four claws projecting from pockets; c, anus; d, intestines and ovaries. B, Toothed *Pentastomum* (*Pentastomum denticulatum*), young. a, mouth; b, double claws; c, intestine; d, future genital opening; e, anus. C, Larva of *Pentastomum teneioides*, showing the two pairs of legs, which are lost in older specimens. D, Egg with embryo.—All greatly enlarged with the exception of A. (A and B after Zuern; C and D after Leuckart.)

cavities of infested dogs have been reported as curative; but prevention is preferable. Many similar species occur in various animals.

ORDER ACARINA (MITES).—Arachnoidea with stout bodies, having the unjointed abdomen consolidated with head and thorax, with biting, sucking, or puncturing mouth-organs, breathing mostly by means of tracheae.

FAM. *Dermatophili*.—*Demodex* (*Simonea*) *folliculorum* Sim. is found in the sebaceous crypts and hair-follicles of the nostrils of man, occasioning the well-known comedones. The mite is distinguished by an elongated, worm-

like, transversely wrinkled abdomen, by a suctorial beak, dagger-like mandibles with two palpi, and four pairs of very short, two-jointed legs, each armed with four claws. The abode of this microscopically small animal is usually filled above with a plug of fatty matter, which in time becomes discolored near the surface, forming the nasty "black-heads." The number of mites found in each of the burrows is very variable, reaching sometimes as many as thirteen. Young and elongated six-legged; older, short, and eight-legged specimens, as well as eggs, are usually found together. Length of mature specimens, about 0.2 mm.

Other species occur in various animals, and frequently occasion serious injury to the infested organs.

The two mites *Pentastomum* and *Demodex* are the lowest forms of the Arachnoidea, but must be placed in the two respective orders. Their poisonous effects are slight, but in exceptional cases quite evident.

FAM. *Sarcoptidae* (*Itch-mites*).—Body microscopically small, stout, soft, with chitinous rods and bands to support legs. No eyes. Skin striated. Tarsi generally provided with suckers. Cone-shaped mouth-parts, consisting of chelate or scissor-like mandibles and maxillary palpi.

Itch-mites have a flat body, more or less circular in outline. The legs extend but a short distance beyond the body; they are supported by chitinous appendages, which look like the garters in the familiar picture of an Italian brigand. In Fig. 2973 the striated surface of the skin is shown, as well as the banded legs and the suckers. The chelate nippers are well adapted to mining galleries in the skin of an infested animal. Like many other animals that lead a burrowing or endophitous life, they need no eyes, and have consequently lost them.

There are numerous species of mites which belong to this family and the genus *Sarcoptes*. The most important one, as affecting man himself, is the *Sarcoptes homini* Raspail, or the *Acarus scabiei* Fabr.*

The itch-mite seems to have been known to Aristotle. The first mention of it occurs in the "Physica St. Hildagardis;" the authoress was living in the twelfth century, in a convent upon the Rupertsberg, near Bingen. The mite is frequently mentioned and described, by some as the cause of the itch, by others as the effect of the disease, while still others have denied its very existence. During the first years of this century the French Academy of Sciences offered a prize of 6,000 francs for the rediscovery of this mite, which had already been closely observed and figured by Wichman in 1780. In the year 1812 a meeting of naturalists and physicians at Paris was greatly mystified and tricked by Dr. Gales, who not only substituted cheese-mites for the itch-mites, and pocketed the prize and medals, but had the audacity

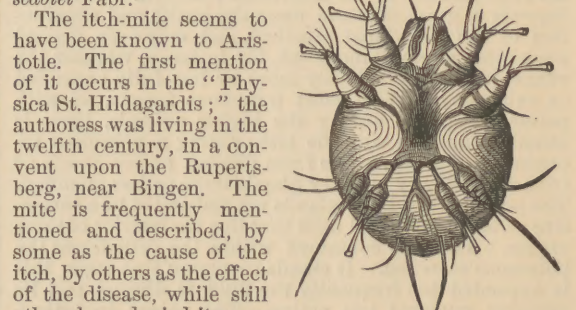


FIG. 2973.—Itch-mite (*Sarcoptes Scabiei*). (After Jeffries.)

* It is doubtful whether Fabricius described the real itch-mite of man or some allied species.

* The illustrations are duly credited in the explanations, the few original figures being drawn and engraved especially for this paper.

to publish descriptions of them. Many naturalists in vain searched for the mite, misled by Gales's book, until in 1829 Lugol offered a second prize to rediscover it. A student of medicine, Renucci, at last, in 1834, showed in Paris a method by which it could be found; he utilized a method used in Corsica and elsewhere, to kill the mites by removing them with a needle. The existence of the itch-mite was thus demonstrated, but whether it was the cause or effect of the disease was a mooted question. It is now well known that these mites are the cause of the disease, which can be produced at will by introducing the mite, and which can as readily be cured by proper means known to every physician.

When examined with the naked eye, the mite looks white and shining, and was aptly described by Bonomo, one of its first observers, as like a little bladder of water; when seen running, however, upon the surface of a plate of glass, it may be perceived that its anterior margin presents a dusky tint of color, and the examination of this part of the creature with the microscope brings into

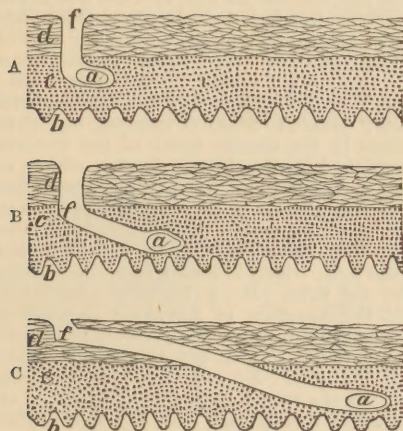


FIG. 2974.—Acarian Furrows. *a*, Position of mite. A, the mite has gone down beneath the epidermis. B, the mite has commenced to dig a longitudinal burrow, and the place (*f*) where it was in A, has by the growth of cells come up nearer to the surface. C, the point (*f*) has come up to the surface, while the mite has gone along farther with its burrow. (After Jeffries.)

view a head not unlike that of a tortoise, and a pair of large and strong legs on each side of the head.

The most apparent difference between the male and the female is the smaller size of the former and the different formation of the two posterior pairs of legs. In the male the third pair are terminated by a long bristle, and the fourth by a pediculated sucker, whereas in the female both third and fourth pairs are terminated by a long bristle. On the under side of the male, moreover, there is a complicated series of chitinous bands, which are not present in the female. When newly hatched, the young *Sarcoptes* has but three pairs of legs, and the hind pair terminate in a long bristle.

The mite lives in the human skin, making little tunnels therein. The female, as she works her way, lays her eggs behind her, to the number of about fifty, and they are said to hatch in from three to six days. If O. Fuerstenberg's illustration in "Die Krätzmilben des Menschen und der Thiere," Leipzig, 1861, may be depended on, which shows a considerable number of eggshells, dropped irregularly all along the burrow, and only one unhatched, close to the mite, we should imagine that the shorter period was the most probable.

The mite changes its skin four times before it attains maturity, and a few days after the last of these moults it obtains the additional posterior pair of legs. This pest was formerly much more common than now. Soap and water, and cleanly habits, have rendered it comparatively scarce; but whenever numerous bodies of men are crowded together, without time and opportunity to attend to their personal cleanliness, it reappears

and rapidly spreads. Armies suffer much from this and other vermin. "The army itch" "the seven years' itch," "the Jackson itch" are terms used for the common itch flourishing under specially favorable circumstances.

The great English authority on skin diseases, Dr. Erasmus Wilson, gives the following as the indications of an attack by this insect, viz.: firstly, a peculiar scaliness and undermined state of the epidermis, which is not met with in other cutaneous affections; secondly, the presence of conical vesicles with acuminate and transparent points; thirdly and principally, the presence of the mite itself, which may be extracted from its retreat beneath the loosened epidermis with the point of any sharp instrument. The diseases which he mentions as apt to be confounded with it are eczema, prurigo, lichen, impetigo, and ecthyma.

When one of the early vesicles of the itch is examined with attention, a minute spot or streak may be observed upon some one point of its surface. This is the aperture originally made by the insect on its first entrance within the epidermis, and from this spot or streak a whitish fluted line may be traced, either in a straight or curved direction, into the neighboring epidermis.

The whitish line is the cuniculus, or burrow, of the acarous; and the fluted or dotted appearance is due to the eggs, the white dots indicating the points where the eggs lie. The burrow necessarily varies in length, being sometimes as much as five or six lines in extent; and at its termination, under a slight elevation of the skin, the little inhabitant lies concealed. The mite may be easily distinguished by the experienced eye as a small dark point at the end of the burrow, and if a thin capsule of skin be raised in this situation with the point of a needle the little creature is brought to view.

The proximate cause of the appearance of itch is the presence of this mite, which is transferred from infected to non-infected persons by actual contact. In some instances it may be conveyed to the person in its adult stage; while in others ova or embryos suspended in the fluid of the vesicles may be the mode of transmission. Certain it is that the application of one of the mites to the skin of a sound person will give rise to the disease. The precise mode of its transmission, however, was for a time a puzzle. Its contagious nature could not be disputed, but it was remarked with surprise that infection among doctors and hospital-attendants was comparatively rare. Dr. Aube set himself to find out the cause of this; and he learned, from a great number of inquiries of patients as to the manner in which they had contracted the disease, that it was almost always by having slept in the same bed with an infected person. He found that the number of those who had so contracted it was to those who had acquired it by manual contact as 100 to 5.

Dr. Aube inferred from this that the mite was a nocturnal animal, and his other observations and an experiment made upon himself confirmed this view. The animal hides under the skin during the day, but walks about at night, perhaps excited by the greater warmth of the body in bed, and pricks the skin in various places. This explains the rarity of contagion during the day, and the small number of burrows that may be remarked on the skin even when there are a great number of pustules; and also why the violent itching only occurs during the night. In confirmation of what we have said, we may quote the statement of Dr. B. Joy Jeffries ("American Entomologist," ii, 118), that in the great hospital at Vienna 1,500 cases are treated yearly, and no attempt at disinfecting the clothing is found necessary. The underclothing should be washed thoroughly, but outside garments, contrary to the general opinion, do not need disinfection.

Treatment for getting rid of the parasite is very simple. Sulphur is the specific. It may be mixed in soap, like the Gishurst Compound and various other similar preparations, or it may be administered in an ointment. By bathing and steeping the parts affected in hot water or vapor, and then rubbing off the skin as much as possible, the *Sarcoptes* is laid sufficiently bare to allow the sulphur to act through the skin upon it. But although

the mite itself is thus easily killed, the eggs are not, and this explains why one application is rarely sufficient; but after a pause of a day or two, during which the surviving eggs may be hatched, the process may be repeated. The newly-hatched insects will thus be killed before they have had time to begin to lay eggs, and as soon as the old crop of eggs is exhausted the cure is complete.

It is not alone on man that this species establishes itself. It has been found on the lion, on the dog, the llama, the sheep, the ox, the horse, and the hog; and although it is possible that some of the observations on which this statement is made are erroneous, and that some allied species peculiar to the animals in question may have been mistaken for the *S. scabiei*, still there is no reason to doubt that as a species it is very widely distributed and found on a great number of different mammals. We hear of old mangy lions in a wild state, but it is only in captivity that they are really attacked by the itch, which no doubt they owe to the dirty attendants who wait upon them. They succumb rapidly to its attacks, dying in a few months, and becoming miserable objects before they die. The head is the part chiefly attacked. It becomes covered with a thick crust, the nostrils closed, the skin swollen into hard folds. In speculating upon the cause of the itching sensation and inflammatory symptoms of the skin in attacks of the Sarcopitides, the first and most natural supposition is that they are caused by the incessant, minute nibbling going on just at the termination of the smallest ramifications of the sentient nerves supplying the skin. Undoubtedly a constant gnawing of this kind must not only produce irritation, but irritation of a kind quite different from any less continuous and minute shaving. But then we have different symptoms produced by different species—the scurfy, inflamed surface of the *S. scabiei*; the coarse, leprosy crust of the *S. scabiei-crustosa*; the deep ulcers of *Glyciphagus hippodoss*; and so on. While it is possible that there may be some difference in the kind and degree of mechanical irritation to produce such different results, yet the presumption is that there is some special poisonous or irritant virus connected with the bite of the different species, and this hypothesis accounts for the variation in the phenomena observed in each.

Several other species of itch-mites infest man, but they are fortunately much more rare. The *Sarcoptes scabiei-crustosa* (the Norwegian itch-mite) was first noticed in 1848. The mite is much smaller and darker, and produces tubercles covered with thick, brownish crusts.

The complaint, as described by M. Boeck in a treatise on the "Spedalskhed," in 1848, is chiefly seated in the hands and forearms, and is characterized by crusts of a dirty-yellow color, of considerable thickness, especially on the hands, where they form a stratum that reaches, and even exceeds, half an inch in thickness, and traversed by broad and deep cracks, which correspond more or less with the articular folds. The bottom of these cracks is moist and whitish; the smell is repellant, and the patient suffers from an incessant and extreme itching. The mites are found in the crust, but not in the substance of the skin.

FAM. Ixodidae (Ticks).—Large, mostly blood-sucking mites, with a tough, leathery tegument; large, saw-toothed mandibles, with from two to four terminal hooks, and with a large spatulate, dentate "glossoid" of the maxillæ, forming a beak. The slender legs end in two claws. Two ocelli frequently present.

These gigantic mites, possessing a tough, smooth, leathery skin, frequently highly ornamented with bright colors and markings, are well known to everyone who has rambled in the country. The skin of the female is capable of much extension. The rostrum, or beak,

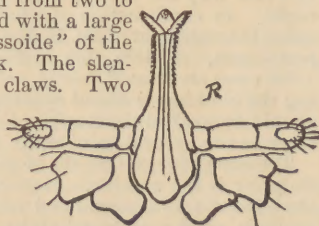


FIG. 2975.—Mouth-parts of Tick (*Ixodes*). R, rostrum. (Original.)

adapted to sucking, is pushed into the skin of the host, and cannot readily be withdrawn, if once inserted, on account of the recurved hooks. The sucking apparatus is situated on each side of the mandibles, where two tubes perform this office. The slender legs, with two claws, possess in the young and six-legged tick a distinct membranous foot-pad, which acts as a sucker. A small shield behind the head is also an important characteristic of these mites. Their young have head- and mouth-parts much larger in proportion to the rest of the body than the adults; the tripartite division of the body is also very distinct, and the thorax is quite distinct from the head and abdomen.

Ticks of various species are common in our woods, preferring the vicinity of roads or houses. From the plants, upon which they patiently wait for a passing host, they find their way to the skin of animals and man, where they fasten themselves, insert their rostrum, and suck the blood. The females distend their large abdomen to such an extent that they grow to the size of a bean; the legs become useless, and the tick is solely kept in position by the inserted rostrum. The abdomen of the male is not capable of distention like that of the female. The young or "seed ticks" cluster upon plants, and from these often crowd upon the exposed parts of man, especially of children, causing intense irritation.

Packard ("Guide to Study of Insects," etc., p. 662) says: "Travellers in the tropics speak of the intolerable torment occasioned by wood-ticks, Ixodes, which, occurring ordinarily on shrubs and trees, attach themselves to all sorts of reptiles, beasts, and cattle, and even to man himself as he passes by within their reach. Sometimes cases fall within the practice of the physician, who is called to remove the tick, which is found sometimes literally buried under the skin. Mr. J. Stauffer writes me that on June 23d the daughter of Abraham Jackson (colored), playing among the leaves in a wood, near Springville, Lancaster County, Pa., on her return home complained of pain in the arm. No attention was paid to it till the next day, when a raised tumor was noticed, a small portion protruding through the skin, apparently like a splinter of wood. The child was taken to a physician, who applied the forceps, and after considerable pain to the child, and labor to himself, extracted a species of Ixodes, nearly one-quarter of an inch long, of an oval form, and brown, mahogany color, with a metallic spot, like silver bronze, centrally situated on the dorsal region." This tick proved, from Mr. Stauffer's figures, to be *Ixodes unipuncta* Pack.

The genus *Argas*, by some placed in a separate family, the *Gasmasidae*, subfamily *Argasidae*, is distinguished by

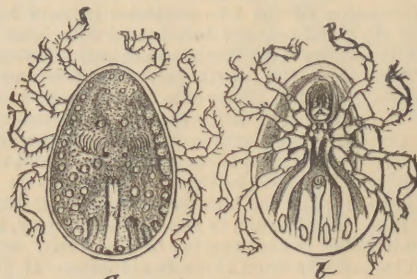


FIG. 2976.—*Argas Reflexus*. a, From above; b, from below. Enlarged. (After Brehm.)

a leathery, flexible skin, which is, however, not smooth, but coarsely covered with granulations or depressions. The whole body, with its anterior part projecting over the mouth, looks quite different from that of the common tick. The first joint of the palpi is usually larger than the rest.

Some members of this genus are much dreaded as very venomous mites, and fabulous stories are told about them. The Persian *Argas* (*Argas persicus*), or the "Mal-leh," is indeed a fearful pest in portions of Europe, Asia, and Africa, and closely allied species occur also

in this country. They inhabit houses, like our common bed-bug, and move about actively during the night, filling themselves with blood, and leaving a very painful wound. They are sometimes so numerous as to force the inhabitants to leave their villages.

Another species, the *Argas reflexus*, is better known. It is usually found in houses where pigeons are kept. It prefers the blood of the young birds, but is very prone to attack man as well. Dr. Boschul put one of these animals in the hollow of his hand; it commenced to bite and drew forth blood for about twenty-seven minutes, and grew during this time to the size of a small bean. The bite appears like a small red dot, and produces violent itching, not so much at the point bitten, but along the veins. Small children bitten by them have symptoms of fever, lasting frequently for a whole week. Like bed-bugs, they never attack during the day. A room lighted by a lamp is a sure preventive of the bites of both.

FAM. *Trombididae*. (Harvest-mites, Red Mites, Jiggers).—Mites distinguished by their bright colors and hairy bodies. Their palpi have generally the second joint longest, while the last bears an appendage of pecu-

1877 (see also *American Naturalist*, March, 1878), where it is shown that the locust-mite (*Trombidium locustarum* Riley) is very beneficial, in the larva or Astoma state, in checking the increase of the Rocky Mountain locust (*Caloptenus spretus*). The small red parasite, which is



FIG. 2977.—*Trombidium Muscarum*. Greatly enlarged. (After Riley.)



FIG. 2980.—B, *Leptus Americanus*. Greatly enlarged. (After Riley.) C, *Leptus irritans*. Greatly enlarged. (After Riley.) (In B and C the dots underneath indicate the natural size.)

frequently seen attached to the common house-fly, is the young of another red mite (*Trombidium muscarum* Riley). But the young of other species are not so useful to man, and the harvest-mites or jiggers are one of his greatest annoyances in the Central and Southern States.

They form one of the most serious obstacles to the enjoyment of rural rambles in summer-time.

The accompanying illustrations will show the transformations of the above-named species; and while those which torment man and the higher animals in this country have not yet been studied through their transformations, they will undoubtedly prove to belong to some species of *Trombidium* or allied eight-legged mite.

The two mites described below cause great annoyance, from harvest-time till into October, to people who frequent the rank herbage and grass in our forest-openings or along our rivers. Both of them are six-legged, reddish, microscopic species, and both of them are popularly termed in the United States "jiggers." This term is evidently a corruption of "chigoe," the name universally applied to the more dangerous *Sarcopsylla penetrans* L., which will be described later, and the term "harvest-mites" is preferable. Allied species are called "harvest-bugs" in England. We quote the following from an article which we communicated to *Colman's Rural World*, St. Louis, for June 21, 1876:

"The American Harvest-mite (*Leptus Americanus* Riley).—This species is barely visible to the naked eye, moves readily, and is found more frequently upon children than upon adults. It lives mostly upon the scalp and under the armpits, but is frequently found on the other parts of the body. It does not bury itself in the flesh, but simply insinuates the anterior part of its body just under the skin, thereby causing intense irritation, followed by a little red pimple. As with our common ticks, the irritation lasts only while the animal is securing itself, and its presence would afterward scarcely be noticed but for the pimple which results.

"The Irritating Harvest-mite (*Leptus irritans* Riley).—This is the most troublesome and perhaps best known of the two, causing intense irritation and swelling on all parts of the body, but more especially around the legs and ankles. Woe betide the person who, after bathing

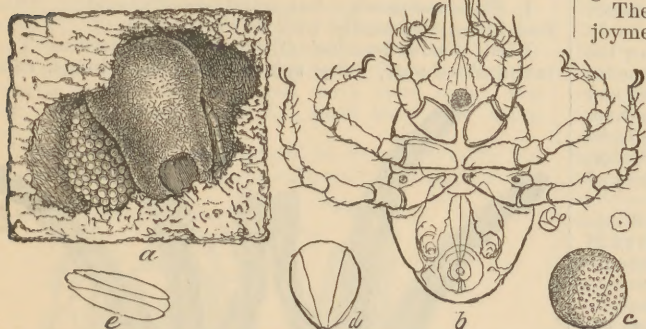


FIG. 2978.—*Trombidium Locustarum*. a, Female with her batch of eggs (after Emerton); b, newly hatched larva—natural size indicated by the dot within the circle; c, egg; d, e, vacated eggshells. (After Riley.)

liar form that can serve as finger and thumb; eyes present. The six-legged larvae are parasitic upon insects and spiders, but they frequently torment animals and man as well, producing sores of various kinds.

Types of this family are the red mites of our fields, the

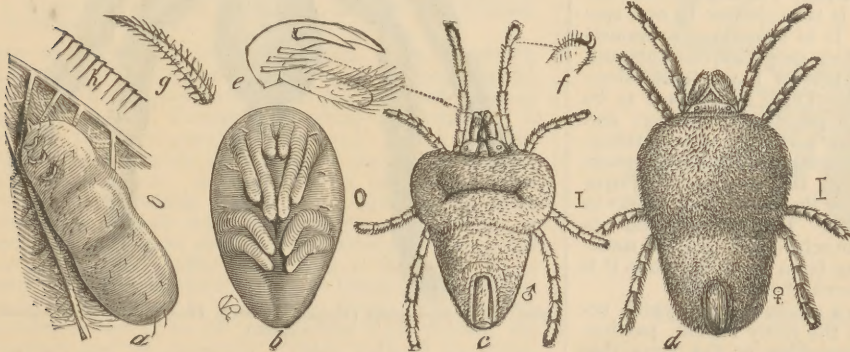


FIG. 2979.—*Trombidium Locustarum*. a, Mature larva when about to leave the wing of a locust; b, pupa; c, male adult when just from the pupa; d, female—the natural sizes indicated to the right; e, pupal claw and thumb; f, pedal claws; g, one of the barbed hairs; h, the striations on the larval skin. (After Riley.)

troublesome red spiders of our hot-houses, and the harvest-mites or jiggers of the meadows.

The transformations of some of these red mites were described and illustrated by us in the "First Annual Report of the United States Entomological Commission,"

in the Mississippi, or anywhere in this latitude, is lured to some green dressing-spot of grass or weeds. He may for the time consider himself fortunate in getting rid of mud and dirt, but he will afterward find, to his sorrow, that he got hold of something far more tenacious in these microscopic harvest-mites. If he has obtained a good supply of them he will in a few hours begin to suffer from severe itching, and for the next two or three days he will be likely to scratch until his limbs are sore.

"With the strong mandibles and the elbowed maxillæ, which act like arms, this mite is able to bury itself completely in the flesh, thereby causing a red swelling with a pale, pustulous centre, containing watery matter. If, in scratching, he is fortunate enough to remove the mite before it enters, the part soon heals. But otherwise the irritation lasts for two, three, or four days, the pustulous centre reappearing as often as it is broken.

"The animal itself, on account of its minute size, is seldom seen, and the uninitiated, when first troubled with it, are often alarmed at the symptoms, and at a loss to account for them. Fortunately, these little plagues never attach themselves to persons in such immense numbers as do sometimes young or so-called "seed" ticks; but I have known cases where, what with irritation and consequent scratching, the flesh has the appearance of being covered with ulcers; and in some localities where these pests most abound sulphur is often sprinkled, during "jigger" season, in foot-gear, as a protection.

"Sulphur ointment is the best remedy against the effects of either of these mites, though, when that cannot be obtained, saleratus-water or salt water will probably allay the irritation. Whether anything better than the sulphur can be used as a preventive I have no knowledge, and shall be glad to learn from those who have had experience. Any oily substance will act as a preventive, and, while kerosene is too offensive, sweet-oil might be tried. I would also recommend for trial alum-water, made by dissolving the alum in hot water, at the rate of an ounce or two to the quart.

"The normal food of either of these mites must, apparently, consist of the juices of plants, and the love of blood proves ruinous to those individuals which get a chance to indulge it. For, unlike the true chigoe, the female of which deposits eggs in the wound she makes, these harvest-mites have no object of that kind, and when not killed at the hands of those they torment they soon die—victims to their sanguinary appetite."

The harvest-bug of Europe (*Leptus autumnalis*, or, according to Murray, *Tetranychus autumnalis*) is very similar to our species. It is sometimes so numerous that crops of currants and other berries have been abandoned. These mites seem to be able to penetrate stockings and drawers, and other thin clothing, for though generally most numerous

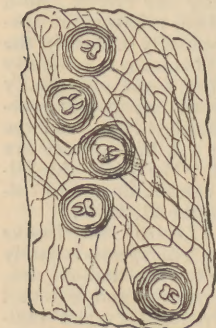


FIG. 2981.—Skin Infested by *Leptus Autumnalis*, showing the Imbedded Heads after Removal of Mites. Enlarged. (Original.)

and annoying about the legs, they are found all over the body. Cats and dogs, from their prowling habits in field and garden, suffer greatly. They scratch and nip their skin with their teeth, so much so that they are sometimes supposed to be suffering from the itch, when it is only from a daily re-enforcement of these mites.

Kirby and Spence mention a similar insect which occurs in Brazil, abounding in the rainy season, particularly during the gleams of sunshine or fine days that intervene, as small as a point, and moving very fast. These animals, they say, get upon the linen and cover it in a moment; afterward they insinuate themselves into the skin, and occasion a most intolerable itching. They are with difficulty extracted, and leave behind them large livid tumors, which subside in a day or two. An insect very tormenting to the wood-cutters and settlers on the Mosquito Shore and Bay of Honduras, and called by

them the "doctor," is thought to be synonymous with this. They add, on authority which they give, that more serious consequences have been known to follow the bite of another mite, related to the above, if not the same species, common in Martinique, and called there the *bête rouge*. When the English soldiers in camp were attacked by these creatures, dangerous ulcers succeeded the symptoms just mentioned, which in several instances became so bad that the limb affected had to be amputated.

ORDER ARANEIDÆ (SPIDERS).—Body consisting of two parts, cephalo-thorax and abdomen, both undivided and connected by a slender pedicel. Mandibles two-jointed, second joint like a claw and movable against the first, either vertically or in a horizontal direction; they contain a poison-gland, which opens by a minute orifice near the apex of the claw. Maxillæ with a prominent leg-like palpus, bearing in the male the accessory genital organs. Labial palpi resemble the legs in form and function. Labium between the maxillæ immovable. Eyes simple, from six to eight. Abdomen provided at apex with four or six spinnerets. Respiration through lungs.

Like most animals which subsist on others, the voracity of spiders is extreme, and they devour not alone all sorts of insects, but also each other. The males are usually very much smaller than the females, and their courtship is by no means unattended with danger, the love of the female being at times truly devouring.

I. *Tetranychus*.—Large and powerful spiders, with four lungs, and mostly with four spinnerets.

FAM. *Theraphosidae* (Bird-spiders, American Tarantulas).—Large, hairy spiders, with four lungs, and



FIG. 2982.—Bird-spider (*Mygalæ Hentzii*). (From *American Entomologist*.)

generally as many spinnerets, of which two are very small.

This family is distinguished by very large, hard, and polished fangs, which move vertically, and can thus be used to pin down their prey. In Brazil they are frequently set in gold and used as toothpicks, possessing, as claimed by the superstitious people, the faculty of keeping away the toothache.

Bird-spiders are unpleasantly numerous in tropical and some sub-tropical countries, and many species are found in the south-western part of the United States, where they are feared because of their poisonous bites. They are nocturnal in their habits, usually hiding during the day in self-made, long, silken tubes, in cracks of the ground, under palm-leaf thatched roofs, and in similar places. They spin no webs to entrap their prey, but either lie in ambush waiting for a victim, or search for it outside, catching it like hunting spiders, by powerful leaps. Insects, and particularly other spiders, form their staple food, but Mr. Otto Lugger, who kept some in captivity, has fed them also with young mice, frogs, and even young snakes. In shedding their skin they lie motionless upon the back, as if dead, until the old skin suddenly breaks in a longitudinal slit between the legs.

The bite of these spiders is quite painful, but not by any means as dangerous as claimed; it produces a violent inflammation of short duration. Scars made by such bites are quite lasting, however, looking like those so frequently made during dissections.

Anane (Mygale) hentzi, a large bird-spider or tarantula not infrequently found even in the Eastern States, has been chosen to illustrate these dangerous-looking animals. *Anane Rileyi* Marx is its California representative, and reputed still more venomous.

II. *Dipneumonae*.—With two lungs and six spinnerets.

FAM. *Lycosidae* (Wolf-spiders).—These rather large spiders are distinguished by a long, oval, elevated cephalothorax, narrowing anteriorly, and eight eyes usually arranged in three rows. Their long and strong legs enable them to chase and catch their prey; during the day they usually hide under stones and chips in silken nests. The females protect their eggs and carry them about, and take care of their young for some time after being hatched.

The most famed and defamed of all spiders is the *Tarantula fasciventris*, which was supposed to cause the dis-

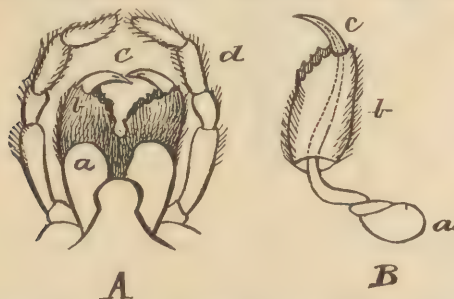


FIG. 2983.—A, Mouth-parts of Genuine Tarantula (*Tarentula Fasciventris*); a, palpi; b, mandibles; c, fang. B, Fang and poison-gland; a, twisted poison-gland; b, mandibles; c, fang with outlet for poison. (From the Gartenlaube.)

ease tarantismus or tarantula dance. The name *Tarantula* is derived from the Italian name *Tarantola*, which is a name for a poisonous spider (or *solofizzi*) common in the vicinity of Taranto, and whose bite was said to produce the most peculiar symptoms. Aldovrandi described very minutely the effects of the bite of a tarantula and the cure. According to his ideas, there is no human disease which cannot be produced by it; those bitten (*tarantulati*) sing continuously, cry, laugh, or weep; some always sleep, others always wake; some perspire or dance, suffer palpitation of the heart; some cannot force themselves to look at black or blue colors, while red or green is pleasant to them. To cure the *tarantulati* the tunes of two dances were played, the *pastorale* and the *tarantola*. These induced the bitten person to dance until he fainted, when he would sleep and rest till cured.

Generally speaking, the bite of a spider is harmless to man, although most spiders possess organs to secrete poison. The larger the spider, the greater the danger; however, the effect of the bite varies with conditions or the season of the year.

The poisonous secretion is an oily, clear fluid, with

acid reaction and a bitter taste. The bite of a tarantula or of a malmignatte kills insects and birds; rabbits are also frequently killed by it. If spiders bite each other, both die after a few moments.

Fig. 2983 shows the poison-fang and gland of the true tarantula of Italy.

The malmignatte (*Lactrodectus malmignatus*) is frequently found in Italy, Corsica, and the Antilles. This spider forms an irregular web upon the ground to catch her prey and hides in a small silken cell in the vicinity. The poison-glands are large, but the fangs are small. This spider appeared in 1830 in large numbers in some regions of Spain, and created widespread fear on account of the poisonous effects of the bite. In 1833 it appeared again, and farmers hardly dared to leave their houses. During the harvest many people were dangerously bitten.

We have had little opportunity to observe the effects of spider-bites.

The effect produced by an American species of the family Attoidae (the *Phydippus tripunctatus* L.), as witnessed by one of our assistants, Mr. O. Lugger, in his own family, was in the nature of a little swelling of the skin, accompanied by great pain, itching, and inflammation. Chilliness and fever succeed each other in rapid succession, and convulsions sometimes take place in children and weak persons. The pain does not cease for several days, and only after free perspiration.

ORDER PEDIPALPI (SCORPION-SPIDERS).—Of large size; elongate and prominent maxillary palpi; first pair of legs very long, slender, and twelve-jointed, resembling antennae, and not used, as in the true spiders, for locomotion. The eleven- to twelve-jointed abdomen is separated from the thorax by a marked constriction, with or without a tail—which, if present, is without sting.

The genus *Phrynus* Oliv. has the general aspect of a



FIG. 2984.—Wolf-spider (*Phydippus Tripunctatus*). (Original.)



FIG. 2985.—*Phrynus Lunatus*. (After Brockhaus.)

spider; the large maxillary palpi are armed with thorns and end in a hand-like organ with one movable finger. The mandibles are free, and probably contain glands to secrete poison, since the bite of these animals is greatly dreaded, though its effect is doubtless exaggerated. Abdomen flat, rather short, eleven-jointed, without a tail. *Phrynus* produces living young, and inhabits the warmer portions of the globe. A number of species occur in our southern and southwestern regions.

The genus *Thelyphonus* Latr. (Whip-tail, Nigger Killer, Mule Killer, Grampus, etc.) looks more like a scorpion. The maxillary palpi are shorter but stouter, and look like the claws of a cray-fish. The last three segments of the abdomen are formed into a short tube, the end of which is continued in a long, jointed, bristle-like tail. The animals possess twelve eyes, and breathe through air-sacs, which open in slits near the posterior margin of the second and third abdominal segments. Although they have a dangerous look, and are generally dreaded in regions where they occur, as in Florida and Texas, they seem to be harmless. Dr. Geo. Marx, who published some notes upon these animals in *Entomologica Americana* for May, 1886, says no poison-glands exist, since no orifice in the terminal mandibular claw could be found by him, such as exist in all other Arachnidae which possess poison-glands in their mandibles. The odor, which some emit as a means of defence, is very penetrating and acidulous, and consequently *Thelyphonus* is vulgarly known by the inhabitants of some of the West Indian islands as the "Vinegar-maker" or "Vinaigrier."

ORDER SCORPIONIDÆ (SCORPIONS).—Distinguished by immense forceps-like maxillæ, seven-jointed præ-abdomen, six-jointed, tail-like post-abdomen, with a venomous sting at the end, in which are lodged two poison-bags. Two large ocelli placed close together in the middle of the cephalo-thorax, and smaller lateral ocelli distributed along its anterior margin. Respiration by means of four pairs of lungs.

Scorpions resemble our cray-fishes, possessing like them immense claws and a rather hard chitinous covering.

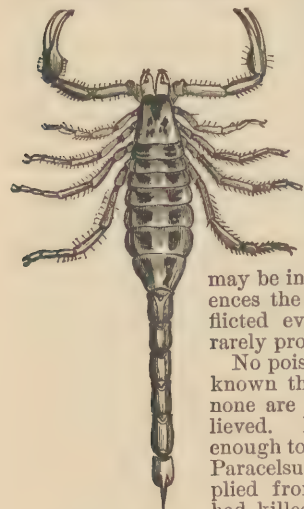


FIG. 2986.—Scorpion (*Buthus Carolinianus* Beauvois). (From *American Entomologist*.)

Their legs are strong, and end in double claws. In their interior organization they are the highest developed of all arachnoideæ. They produce living young. Some reach a very large size and are able to endanger even the life of man. They are dangerous in proportion to their size, their age, and the state of irritation they may be in. Temperature also influences the venom. The wounds inflicted even by the largest species rarely prove fatal.

No poisonous arthropod is better known than the scorpion, and about none are more fables told and believed. Its forbidding aspect is enough to account for many of these. Paracelsus claimed that they multiplied from rotting scorpions which had killed themselves for this purpose, a belief evidently based upon the story that scorpions surrounded by glowing embers would kill themselves. Recent experiments would

indicate that even this story is but fable. Scorpions may be provoked to strike and wound themselves or each other, but they are incapable of causing any toxic action upon themselves or upon other scorpions. According to Kirby and Spence, the only means of saving the lives of the English soldiers who were stung by them in Egypt was amputation, and they add that one species was said to occasion madness. There is no doubt that the sting of certain kinds common in South America causes fever, numbness in various parts of the body, tumors on the tongue, and dimness of sight, which symptoms last from twenty-four to forty-eight hours. Our common southern species, the *Buthus carolinianus*, which ranges from the Southern Atlantic States, through Texas, northward into Southern Kansas, inflicts also a very severe sting, which hurts for many hours.

The sting is not barbed, but its point is perforated, and it wounds simply by penetrating the skin and conveying poison into the wound through two orifices

from a poison-bag. The poison is sometimes as white as milk.

Scorpions are common in tropical and sub-tropical parts of the world; they leave their retreats at dusk, running with their tail raised over their back, pointing forward. Their food consists mainly of spiders and large insects, which they grab with their claws, and, after scrutinizing, kill with their sting. During the day they hide under stones, in rotten wood, and in dark places. They are very fond of warmth, and frequently enter houses, and hide in beds, clothing, shoes, etc., so that travellers in the tropics always run the risk of being stung by them. Liquid ammonia, even the ashes of tobacco, moderate the pain very quickly, and a small dose of ipecacuanha will overcome the faintness. The effect of the sting upon a person diminishes in virulence with repetition, and may become innocuous.

ORDER SOLIFUGÆ (GALEODES).—Spider-like animals, having head and thorax separated, with a long, segmented abdomen, scissor-shaped mandibles, and leg-like maxillary palpi; they breathe through tracheæ, and not by pulmonary sacs.

These large, hairy, and spider-like animals, reaching sometimes a length of two inches, are at once distinguished from true spiders by the segmented, elongated abdomen. They resemble, in the division of their body, true hexapod insects, because their cephalo-thorax is divided in two parts, of which the anterior part may be compared with the head, and the posterior three-jointed part with the thorax of insects. The cylindrical abdomen, formed by nine or ten segments, is strongly separated from the cephalo-thorax. The mouth organs con-



FIG. 2987.—*Datames Striatus*. B, Side view of head of female. (After Putnam.)

sist of very large mandibles, ending in a large vertical pair of scissors, of which the lower arm moves in a vertical direction against the upper arm, which is also movable. The maxillary palpi serve as legs, but lack the claws, which are found only in the three pairs of posterior legs, which originate from the thoracic segments, and which possess upon their base peculiar leaf-like appendages. The first pair of legs, starting from the head, might be mistaken for a second pair of maxillary palpi. Galeodes possesses two large projecting ocelli and breathes, like insects, through trachea. Two of the four stigmata open between the first and second pairs of legs, and two on the ventral side of the abdomen.

Pallas narrates wonderful stories of one of the species of Galeodes, which is common in Southern Russia, where it is greatly feared and called the Bu-Chorgoi, or Kara-Kart-Bie. People leave a region in which this animal, considered dangerous to man and beast, is common. It is claimed that during the summer, when camels are more or less denuded of hair on their ventral side, these Galeodes appear, and, jumping upon the sleeping animals, poison them. According to the superstition of the Kal-mucks, if a person is bitten but one remedy will cure him—the milk of a woman in her first confinement, providing she was immaculate as a girl. If such milk cannot be had, the heart or lung of a black dog or cat is torn out of the living animal and applied to the wound.

Physicians during the time of Pallas effectually used nut-oil, or cotton saturated with camphor. The viciousness of these creatures in attacking when interfered with, as well as the formidable nature of the large mandibles, plainly indicates that they have both the will and the power to inflict a severe bite. No cases have come under our notice, but the bite of some species is said to be very painful, producing violent inflammation, passing lameness, headache, and fainting fits. Experiments that have been made prove the dangerous qualities of the bite, though there is doubtless great variation in this respect in the different species. The many species which occur in this country usually live in sandy deserts, where they dig pits in the soil, removing the debris by means of their mandibles and stiff hairs, which act as a broom. During the day they hide; and they search for their food, chiefly grasshoppers, during the night. The food is not simply sucked dry, but is completely chewed up. Small lizards, young mice and rats, and even specimens of their own kind, do not escape their voracity. Their only redeeming character is the love for their offspring, which they protect carefully.

The best-known American species is the *Solpugo* (*Galeodes*) *americana* Say, which runs with amazing rapidity, like our well-known sand-crab.

CLASS MYRIAPODA (THOUSAND-LEGS.)—Tracheates with free head and numerous, nearly uniform segments, with one pair of antennae, three pairs of palpi, and numerous legs.

Thousand-legs are distinguished from all other arthropods by the uniform segmentation of their cylindrical or flat bodies, and the mode of their locomotion. This class is divided into two orders, the *Chilognatha* and the *Chilopoda*. The most important character, so far as we are now concerned, is that the one has its jaws or mandibles formed on the ordinary plan found in hexapods that bite their food; while the other has them formed out of its fore-legs into something half-leg, half-jaw, after the shape of the falcis of spiders, with a sharp point and a hollow duct inside; which is connected with a poison-gland. The former compose the *Chilognaths*, with two pairs of legs to each segment; the latter the *Chilopods* or *Scolopendridae*, with one pair of legs to each segment. The former are harmless, and it is with the latter that we have to deal in this connection.

ORDER CHILOPODA (CENTIPEDES).—Distinguished by a flat body with one pair of legs on each segment; long and many-jointed antennae; mouth-organs fitted for carnivorous food; poison-glands in base of first pair of legs, which resemble mouth-parts.

FAM. *Scolopendridae*.—Chiefly distinguished by the relatively few segments and few ocelli.

This family contains the most formidable and largest species, some reaching nearly a foot in length. As stated by Professor H. C. Wood, Jr., in "The Myriapoda of North America," their highly organized muscular and

nervous system, the compactness of their intestinal apparatus, and the length and power of their legs, all betoken habits of great activity, while the formidable nature of their mandibles, and the sharp spines, both lateral and terminal, with which their feet are armed, fit them for predatory warfare. The poison-fangs are very strong, and the bite dangerous.

Brown, in his "History of Jamaica," in speaking of *Scolopendra morsitans*, says: "Another example of the severity of the bite came within our own personal knowledge. The sufferer was the manager of a sugar plantation in Jamaica in bygone days, when there were still slaves; and in the 'boiling season,' when the juice of the cane is boiled to produce the sugar, it was his duty or practice to visit the boilers during the night, to see that the fires were kept up and no intermission was allowed in the process. On these occasions, he merely threw on a dressing-gown and thrust his naked feet into slippers, while he took a hasty round through the works. While thus engaged he was once bitten on the leg, a little above the ankle, by one of these large centipedes. They are nocturnal animals, and of course most lively and alert at night. He described the pain as so excruciating that he almost fainted on the spot, and had to be assisted into the house. As to the structure of the apparatus for poisoning the wound made by the bite, that was satisfactorily made out by Mr. Newport, the eminent entomologist, whose loss is still deplored by our older naturalists. Until he worked it out, the gland by which the poison of the centipede is secreted had not been shown. Leewenhoeek discovered at the apex of the mandibles an orifice that communicated internally with an elongated cavity, and he also saw a drop of fluid exude from the orifice, but he did not discover the true secreting gland, which, however, Newport did, for he not only confirmed Leewenhoeek's observation in regard to the existence of a longitudinal opening at the inner margin of the apex of the mandible, but also traced it backward to the sac with which it communicates, and discovered the gland of which it is the reservoir." The effect of the bite of a centipede in warm climates is very variable; sometimes excessively virulent and painful, at others causing little inconvenience.

Geophilus subterraneus is one of those species which have the remarkable property of occasionally (more especially in spring and autumn) secreting a phosphoric substance, which seems to exude from the body, and is left like a shining trail on the spots over which the centipede has passed. The light soon fades and disappears, however. This is the species whose luminosity has been most frequently observed, but there are reasons for believing that the property is common to all the section of centipedes known as *Geophilidae*, and that it is evolved only at the breeding season. Oviedo, the friend and companion of Columbus, as quoted by

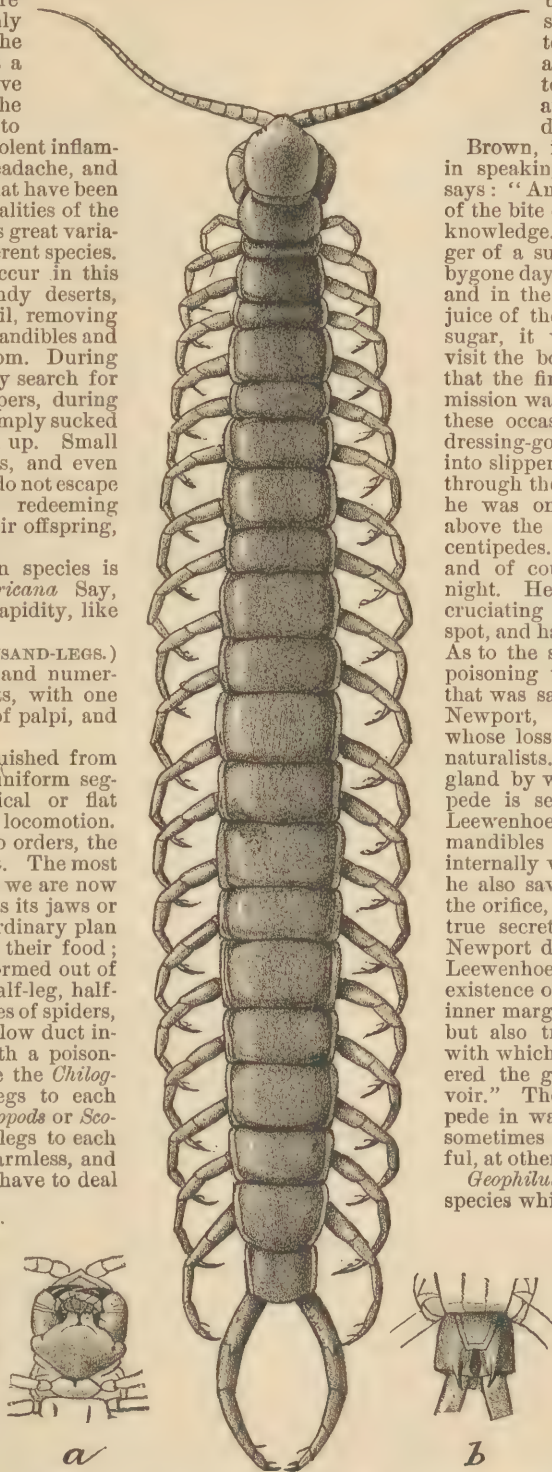


FIG. 2988.—*Scolopendra Castaneiceps*. *a*, Under side of head, showing fangs; *b*, under side of last segment. (After Wood.)

Newport, mentions it in his account of the island of St. Domingo: "There are in this island (St. Domingo) many kinds of *Scotopendra* or hundred-legs; some are slender and as long as one's finger, and like to those of Spain, and these bite and cause considerable pain. There are others of these worms about half the length of the finger and slender, with many feet, and these shine much by night, and leave a light where they go, and may be seen fifty or even one hundred feet off. Yet the whole animal does not shine, but only the joints where the legs spring from the body, and the light is very bright." From this property this species, or the *longicornis* (it is doubtful which he meant), was named by Linnæus *Scotopendra electrica*.

Numerous observations are recorded of myriapods of this section, after having caused lingering headache, having been sneezed forth by men from the nose. As Van der Hoeven says, it is easier to reject these observations than to explain the continued life of these creatures in such unusual situations.

CLASS HEXAPODA (INSECTS PROPER).—Tracheates, with body distinctly divided into head, thorax, and abdomen. Head with two antennæ, and either haustellate or mandibulate mouth. Thorax with normally three pairs of legs, and with either four, two, or no wings. Abdomen normally nine-jointed.

ORDER NEUROPTERA (NERVE-WING INSECTS).—These insects are characterized by having the wings reticulate with numerous veins, so as to look like network.

The order forms two natural divisions, the first including all those which undergo a complete, and the second those which undergo an incomplete, metamorphosis. The order does not contain any poisonous species. The male of *Corydalis cornutus* is feared by the ignorant without cause. Its female can and will nip the fingers, but, not possessing any poison, produces only momentary pain. The *Panorpidae* (Scorpion-flies) are dreaded by some persons. The males are distinguished by a peculiar anal organ, which very closely resembles the tail end of a scorpion; but it cannot be used for any similar purpose.

ORDER ORTHOPTERA (ROACHES, LOCUSTS, GRASSHOPPERS, ETC.).—These insects are characterized by having the front wings straight and usually narrow, pergamenous, or parchment-like, thickly veined and overlapping at tips when closed; the hind wings large and folding longitudinally like a fan. Transformations incomplete.

This order contains no venomous species. Members of the family *Forficulidae* (Earwigs) are erroneously considered poisonous by many people; they are perfectly harmless, so far as venomous qualities are concerned. The oft-mentioned fact that they enter the ears of persons sleeping outdoors, is not disputed; but they enter in search of a dark hiding-place.

The family *Blattidae* (Roaches), so injurious to his property, are perfectly harmless to man himself.

The family *Acrididae* (Locusts or Grasshoppers) never occasion bodily harm to man, but it is claimed that flights of the migratory African species have at times spread the germs of cholera to regions far away from the seat of this disease. Some members of this family secrete very corrosive juices, which they drop upon the person handling them.

ORDER RHYNCHOTA OR HEMIPTERA (BUGS).—Insects with jointed beak (rostrum), fitted for penetrating and sucking the juices of plants and animals. Prothorax mostly free. Metamorphoses incomplete.

In this order we have a number of species which are more or less poisonous. Most true bugs (sub-order *Heteroptera*) secrete poison to produce an accelerated flow of their food, either the sap of plants, or the blood of insects and animals. The sub-order *Aptera* has apparently no organ to secrete such poison, but the saliva itself is more or less irritating, and the bite is not simply a mechanical perforation of the skin.

SUB-ORDER APTERA OR PARASITICA.—Wingless Rhynchota, with short, fleshy rostrum and broad, cutting setæ; sometimes with rudimentary biting mouth-organs. Thorax ill-defined. Abdomen generally nine-jointed.

FAM. Pediculidae (Lice).—Schödte, a Danish entomolo-

gist, has, it seems to us, forever settled the question as to whether the louse bites the flesh or sucks blood, and decides a point interesting to physicians, *i.e.*, that the loathsome disease called phthiriasis is a misnomer. From this source not only many living in poverty and squalor are said to have died, but also men of renown—among whom Denny, in his work on the Anoplura, or lice, of Great Britain, mentions the names of "Pheretima, as recorded by Herodotus, Antiochus Epiphanes, the Dictator Sylla, the two Herods, the Emperor Maximilian, and Philip the Second." Schödte, in his essay "On Phthiriasis, and on the Structure of the Mouth in Pediculus" (*Annals and Magazine of Natural History*, 1866, p. 213), says that these statements will not bear examination, and that this disease should be placed on the "retired list," for it cannot be produced by mere blood-sucking animals, which in this case are only the disgusting attendants on other diseases. He thus describes the mouth-

parts of the louse, his studies having apparently been on *vestimenti*:

"Lice are no doubt to be regarded as bugs, simplified in structure and lowered in animal life, in accordance with their mode of living as parasites; being small, flattened, apterous, myopic, crawling, and climbing, with a conical head, moulded as it were to suit the rugosities of the surface they inhabit, provided with a soft, transversely furrowed skin, probably endowed with an acute sense of feeling, which can guide them in that twilight in which their mode of life places them. The peculiar attenuation of the head in front of the antennæ at once suggests to the practised eye the existence of a mouth adapted for suction. This mouth differs from that of the Hemiptera (bed-bug, etc.), generally in the circumstance that the labium is capable of being retracted into the upper part of the head, which therefore presents a little fold, which is extended when the labium is protruded. In order to strengthen this part, a flat band of chitine is placed on the under surface, just as the shoemaker puts a small piece of gutta-percha into the back of an india-rubber shoe; as, however, the chitine is not very elastic, this band is rather thinner in the middle, in order that it may bend and fold a little when the skin is not extended by the lower lip. The latter consists, as usual, of two hard lateral pieces, of which the fore-ends are united by a membrane so that they form a tube, of which the interior covering is a continuation of the elastic membrane in the top of the head; inside its orifice there are a number of small hooks, which assume different positions according to the degree of protrusion; if this is at its highest point the orifice



FIG. 2989. — Mouthparts of Louse (*Pediculus Vestimenti*). *a, a*, The summit of the head with four bristles on each side; *b, b*, the chitinous band; *c*, the hind part of the lower lip; *d, d*, the foremost protruding part of the lower lip (the haustellum); *e, e*, the hooks turned outward; *f*, the inner tube of suction slightly bent and twisted; the two pairs of jaws are perceived on the outside as thin lines. (After Packard.)

is turned inside out, like a collar, whereby the small hooks are directed backward, so that they can serve as barbs. These are the movements which the animal executes after having first inserted the labium through a sweat-pore. When the hooks have got a firm hold, the first pair of setæ (the real mandibles transformed) are protruded; these are, toward their points, united by a membrane so as to form a closed tube, from which, again, is inserted the second pair of setæ, or maxillæ, which in the same manner are transformed into a tube ending in two small lobes placed crosswise. It follows that when the whole instrument is exerted, we perceive a long, membranous, flexible tube hanging down from the labium, and along the walls of this tube the setiform mandibles and maxillæ, in the

shape of long, narrow bands of chitine. In this way the tube of suction can be made longer or shorter as required, and easily adjusted to the thickness of the skin in the particular place where the animal is sucking, whereby access to the capillary system is secured at any part of the body. It is apparent, from the whole structure of the instrument, that it is by no means calculated to being used as a sting, but is rather to be compared to a delicate elastic probe, in the use of which the terminal lobes probably serve as feelers. As soon as the capillary system is reached, the blood will at once ascend into the narrow tube, after which the current is continued with increasing rapidity by means of the pulsation of the pumping ventricle and the powerful peristaltic movement of the digestive tube."

The head-louse (*Pediculus capitis* Deg.) is usually, almost exclusively, found upon the head of children. The well-known "nits," which are glued to the hairs of the host, are the eggs of this species. It is generally supposed that dirt and filth breed these vermin; such is, however, not the case. Of course, upon a dirty head they find more suitable quarters and greater abundance of their appropriate food than upon a clean one. Oil and cleanliness are the best prophylactics.

The body-louse (*Pediculus vestimenti* Burm.) is more frequently found upon the nape of the human neck, and was consequently named, by Linn., *cervicælis*. It is found, however, upon any part of the body not covered with a dense growth of hair. During our civil war it was unpleasantly well known to the soldiers by the characteristic name of "gray-back." The prevalence of this insect during that time was owing to the fact that soldiers were either unable to properly wash their clothing in hot water, or not as often as most of them would like to have done. This insect differs from the other species by a distinct blackish stripe which commences between the hind legs, and reaches about two-thirds of the way to the tip of the abdomen. The male is further distinguished by a very long, robust, and blunt spur at the tip of the front tibiae.

The crab-louse (*Phthirus pubis* Linn.) is characterized by a much more rounded and flattened shape, and by the four crab-like posterior legs. Its habits are also quite different, although, like the other members of this family, it attaches its eggs to the hair; the young, instead of living on the surface of the skin, burrow under the epidermis, causing intolerable itching. When mature they leave their burrows to procreate.

There is a large number of species affecting our different domestic animals. All, as well as their eggs, can be readily killed by an application to the infested portions of the body of any kind of mercurial ointment.

FAM. *Mallophaga* (Bird-lice).—Distinguished from the lice by possessing three- to five-jointed antennæ, and by a biting mouth instead of a fleshy rostrum.

A great number of species, including the well-known bird-lice, are comprised in this family. They are found upon mammals and birds, and feed upon the young hairs and feathers, but imbibe, in some cases, blood as well.

SUB-ORDER HOMOPTERA (WHOLE-WING BUGS).—These insects are characterized by having all four wings of a uniform membranous nature, and folding straight down the back when at rest. Transformation incomplete.

None of the species of homoptera are positively known to be poisonous to man, though many produce poisonous effects on plants. The oft-told story of the venomous effect of the puncture, or "sting," of the periodical cicada (miscalled seventeen-year locust) lacks sufficient proof. The matter is fully considered in our writings on this interesting insect, *Cicada septendecim*, with its race *tredecim*. Cf. more particularly Bulletin No. 8, Division of Entomology, Department of Agriculture, and Annual Report of U. S. Entomologist for 1884.

SUB-ORDER HETEROPTERA (HALF-WING BUGS).—These insects are characterized by having the basal half of the front wings coriaceous or leathery, while the apical part is membranaceous. The wings cross flatly over the back when at rest. Transformations incomplete.

In this sub-order there are a large number of species which can inflict by their "bite" or puncture severe pain to man and animals. But most of those which possess this power normally live upon other insects.

The rostrum or beak of these insects is a horny, pointed, tapering, three- or four-jointed tube, the *labium*, and arises from beneath the front of the head. This tube encloses four stiff bristles, the mandibles and maxillæ, which are adapted to pierce the tissues of plants or animals. In plant-feeding species the rostrum is unusually long and slender; in blood-sucking species it is short, thick, and curved. When plunging the beak into the flesh, the setaceous maxillæ and mandibles—the latter armed with recurved teeth—come into action, and a drop of fluid is discharged at the same time from the salivary glands; this fluid, the poison, is of an acid nature, and will, on this account, produce inflammation and an accelerated flow of blood. It would be useless even to mention all the species involved, and only the more dangerous, or the more common and best-known species, will be referred to in this connection.



Fig. 2990. — Point of Beak of a Hemipteron.



Fig. 2991. — Rostrum of *Notonecta*.
b, Side view of rostrum; d, rostrum from above; e, one of the mandibles entire, and the base of the other and of the two maxillæ; f, extremity of mandible more strongly magnified, with recurved teeth; g, upper lip; g, antenna. (After Westwood.)

FAM. *Notonectidæ* (Water Boatmen).—Aquatic insects, always swimming on their back; they are oval in form, and deeper-bodied than other aquatic bugs, having the convexity of the surface above. Eyes large, reniform; four-jointed rostrum elongate, conical, acute; ocelli absent.

The species of the genus *Notonecta* have a sharp, poisonous bite. They do not usually attack man, but try to escape from him. If, however, they are roughly handled they bite freely, and occasion very great pain, which lasts sometimes for hours. Ponds that are drying out in summer, and where these species collect in large numbers, should not be used for bathing purposes.

FAM. *Nepidæ* (Water Scorpions).—Flat, elliptical, aquatic insects of a dull, fuscous, or brownish color; legs better fitted for walking than swimming, with the fore-tibiae curved, carrying a long, one-jointed tarsus, and fitting into a channel of the long and wide femora like the blade of a pocket-knife. Eyes prominent; abdomen terminating in two long respiratory half-tubes, which united serve to convey the air to the interior of the abdomen.

Although these insects are very sluggish in their motions, they should be handled with care, as they are also capable of a sharp and severe bite.

FAM. *Belostomatidæ* (Giant Water Bugs).—The brown or gray insects forming this family contain the largest heteroptera now in existence. They are broad and flat-



Fig. 2992. — *Belostoma Americanum*. (After Riley.)

bodied aquatic insects, more or less ovate, the hind legs being flattened and adapted for swimming, the front tibiae curved and fitted for seizing and holding their prey.

The *Belostoma americanum* Leidy, since the introduction of the electric light in our streets, has become a rather well-known insect, being attracted to the light in great numbers; and easily stunned by the force of its flight against the lamps. It is injurious to young fish,



FIG. 2993.—*Opsicentus* (*Reduvius*) *personatus*. b, Imago; c, larva. (After Riley.)

and its puncture is painful, and, while very rarely wounding man, it should be handled carefully.

FAM. *Reduviidae* (Pirate Bugs).—This family, comprehending a vast number of forms, is distinguished by having the rostrum attached to the tip of the head, with the basal joint bent, thus causing the rest to curve beneath, and usually fitting in a groove upon the sternum. Eyes

prominent, hemispherical, lateral, and placed before the base of the head; when situated far back they are succeeded by a constriction resembling a neck.

Nearly all of the numerous species of this family have a more or less poisonous bite. The great majority show, however, but little inclination to bite man, until forced in self-defence to do so. In Europe the Cannibal bug (*Reduvius personatus* Linn.) (Fig. 2993) haunts houses for the sake of preying upon the bed-bug. Recent writers contend, however, that instead of taking the blood from the bed-bugs, they prefer to take it directly from the original source, so that the very commendable propensities of this insect are offset by its making no distinction between bed-bug and man. Its larva (Fig. 2993, c) is covered with a glutinous substance to which bits of dirt and dust adhere. Both the imago and the immature larva and pupa have a very peculiar mode of locomotion. They all move very deliberately, step by step, with a long pause between each motion, which is executed in a sudden and jerky manner; their antennae move at the same rate. If a fly or another insect is offered it is first touched with the antennae, a sudden spring follows, and at the same time the beak is thrust into the prey.

The Two-spotted Corsair (*Pirates biguttatus* Say), Fig. 2994, is in the Southern States found in similar places, and is also said to prey on bed-bugs.

The blood-sucking Cone-nose, or Big Bed-bug (*Conorhinus sanguisuga* Lec.), Fig. 2995, is also frequently found in beds, and its bite is very severe. Prof. J. G. Lemmon, of Oakland, Cal., has reported his experiences with this insect in the Annual Report of the Entomologist for 1884. He was induced, after a botanizing exploration in the



FIG. 2994.—*Rasahus* (*Pirates*) *biguttatus* Say. (After Riley.)



FIG. 2995.—*Conorhinus Sanguisuga* Lec. a, Imago; b, pupa. (After Riley.)

mountains of Arizona, to camp with his family in a cave. He writes: "Suddenly Mrs. Lemmon screamed, and a large, flat, nimble-footed bug was seen hurrying away into a rock crevice. It was pitiful to see the tears rolling down her cheeks as she swung her arm about, while applying ammonia to allay the pain of the wound, which

immediately reddened and swelled, forming a convex surface one inch or more across." Others were also bitten. The presence of this insect is not felt until the keen beak is inserted; this is very hard, over 3-16 of an inch long, and can, therefore, be inserted through any kind of clothing worn in summer. The swellings made soon fester, occasioning great pain and itching, and discharging pus for several days.

Besides these species sometimes found in houses, there are others, seldom or never found under roof, but equally poisonous. As an example we select the *Prionidius cristatus* Linn. This well-known insect, called the "Wheel-bug," on account of the arched and serrated projection on its back, is by no means quarrelsome, but evades man. Its puncture, however, produces violent inflammation, and the bitten hand and arm are rendered useless for some time. Being otherwise a very useful insect, by preying on various other plant-feeding pests, it should be spared and protected.

A species allied to our wheel-bug occurs in Chili, where it is called "winhuka," or "rinhuka." It is there greatly feared, and if numerous, is said to drive people for a time from their dwelling-places.

FAM. *Cimicidae*.—These insects are distinguished by a broad head, with the frontal division bluntly rounded; the antennae have the two basal joints stout, the first being very short and much thicker than the second, while the two end-joints are very slender and pubescent; rostrum slender, excepting the base, and extending to the fore-coxae.

This family contains as its representative the best-known of all bugs, the bed-bug (*Acanthia lectularia* Linn.). Few people who live in crowded cities will require a figure of this insect in order to recognize it. It is best known as a household pest, but is not infrequently found on some kinds of timber in the woods. Its rudimentary wings and wing-cases indicate that it has undergone a kind of domestication, and has been influenced by man for a very long time. Thus far no individuals of this insect have been met with fully winged, though specimens occur, which have the wing-pads hanging loose, as if ready to change into wing covers. The old Greeks knew it by the name of "koris," and the Romans called it "cimex."

The female deposits about fifty eggs in March, May, July, and September. These eggs are white, 1.12 mm. long, and are hidden in the finest cracks which our rooms afford; behind loose wall-paper, but particularly in recesses which the bedstead affords. Only the full-grown bugs hibernate, or are able to endure a great degree of cold. Nearly the whole year is required for full growth. Notwithstanding their bloodthirsty habits, they can fast for many months. Leunis confined a female in a tight-fitting paper-box, and after six months found the female living and surrounded by a whole brood of young ones—all as transparent as glass.

The judicious use of kerosene or of corrosive sublimate will disinfect a house of this pest.

These nocturnal bugs attack, besides man, chickens, pigeons, swallows, and bats, and it is probable that originally they led a parasitic life outside of human habitations.

The above are the more common Hemiptera or true bugs which come under notice in this country because of their poisonous bite. There are many other species, and beyond the bed-bug, which is ubiquitous, each country has species peculiar to it which the limits of this paper forbid discussing.

ORDER DIPTERA (TWO-WINGED FLIES).—Insects with sucking or piercing mouth-organs. Two front wings, and two balancers in place of hind wings. Metamorphoses complete.

SUB-ORDER PUPIPARA (LOUSE-FLIES).—Body stout, the three thoracic segments consolidated, abdomen broad and flat. Head immersed in the thorax; antennae short, frequently but two-jointed; claws denticulated; wings present and rudimentary, or entirely lacking. The rostrum is formed by the labium and maxillae, and contains three pointed setae.

Some of these parasitic flies live upon the skins of our domesticated animals and birds. If numerous they produce ulcers. These flies are mainly interesting from the fact that they do not deposit eggs, but retain and hatch them in an uterus-like organ. The maggot feeds there upon the secretion of numerous glands, molts several times, and is born just before the last stage has been reached.

SUB-ORDER BRACHYCERA (FLIES PROPER).—Body of various shapes; head always distinct from thorax; claws not dentated; wings almost always present; antennæ short, usually three-jointed; females oviparous or larviparous.

FAM. Muscidae (House-fly, etc.).—Distinguished by a short, thick, membranaceous proboscis, terminating in two large labial lobes, and retractile within the oral cavity; the proboscis encloses only two internal setæ.

A large number of flies belong to this family, whose bite, and even contact, may produce serious consequences to man. Their usual shape is that of the common house-fly.

The absence of house-flies (*Musca domestica* L.) for a season is believed to be an indication of unhealthfulness. Whatever foundation there may be for this belief is due to the fact that flies are the best and most numerous destroyers of disease-breeding materials. They are scavengers—buzzards on a small scale. Flies consume in their larval state decaying animal and vegetable matter, and the amount of such putrid material in cities is beyond calculation.

The house-fly is in itself not poisonous, but may endanger our lives by carrying disease-germs on its feet and hairy body. Moreover, flies are capable of eating the ova of various parasitic worms, discharging them unchanged in their faeces. The distribution of the human parasite, *Tricocephalus dispar*, as Dr. Grassi has proved, is aided by the agency of the common house-fly. Even the eggs of the tape-worm (*Tenia solium*) may be thus distributed.

Musca Cæsar L., *Musca vomitoria* L., *Sarcophaga carnaria* L., and other well-known, bright-colored flies, may similarly communicate diseases.

The dreaded "screw-worm," of the Southern States, is the larva of *Lucilia macillaria* L. These worms have long been well known to injure and even kill various domestic animals, such as sheep, horses, and cattle. But of late years many cases have occurred where human beings have been the victims as well. The nostrils of man or beast are generally selected by the *Lucilia* for the deposit of her eggs or the young maggots. People suffering from nasal catarrh, or subject to frequent bleeding of the nose, always run great risk by sleeping outdoors. Professor F. H. Snow has published a long account of the hominivorous habits of this fly in "Psyche." Other papers have been published in the *American Entomologist* and elsewhere. The maggots destroy the soft palate, so that the tongue cannot be protruded and used for speaking. The discomfort to the patient is not very great, until the Schneiderian membrane is affected. The worms burrow under the palatine fascia, which presents a honeycombed appearance, and is entirely destroyed in large patches. After death it was found, in one case mentioned by Dr. J. B. Britton, of Mapleton, Kansas, that all the tissue covering the cervical vertebrae, as far down as he could see by throwing the head back and compressing the tongue, had been wholly destroyed and the vertebrae were exposed. The os hyoides was also destroyed, and the nasal bones were held in position only by the superficial fascia. As many as three hundred maggots were forced in one case from the mouth and nose of a patient before death relieved his sufferings. It is very difficult to reach these maggots when once lodged high up in the ethmoid cells or frontal sinus. Injections with carbolic acid solution of moderate strength, or with olive oil, warm water applications, and a proper use of chloral, are recommended. Pyrethrum is a never-failing remedy for the screw-worms in all cases where they can be reached.

The hominivorous propensities of these flies have

gained for them the synonyms of *Lucilia hominivorax* Coquerel, and in South America *L. hominivorus* Cenil.

Quite a number of cases are on record where the viviparous *Sarcophaga* have dropped their young in ulcers of men, causing death. In the tropics a large blue fly, belonging to this family, has the dangerous habit of depositing eggs or living young in the nose, causing severe pain and irritation, and, according to some authors, death. The maggots of *Sarcophaga latifrons* have been removed from ulcers in the ear, and other cases are on record, where such maggots had penetrated the eye, thus destroying its vision.

The *Stomoxys calcitrans*, a member of the family *Stomoxys*, but bearing a close resemblance to the house-fly, is well known by its annoying bite. Though usually found near stables, it does not hesitate to enter houses.

FAM. Oestridæ (Bot-flies).—These flies are distinguished by having the mouth completely obsolete, no other traces being visible except two or three minute fleshy tubercles.

Many of these large flies are very troublesome to our domesticated animals. Their larvæ or grubs live either under the skin of their host, or are found fastened to the linings of the stomach, or of intestines, or in the nostrils, and frontal sinuses.

The Ox bot (*Hypoderma bovis* L.) is the best known in this country. The larvæ hatch from eggs deposited by the mother-fly in the hide of living cattle, and produce the ulcers popularly known as "worms" (worm-holes). Our rabbits are also frequently infested by the similar worms of *Cuterebra cuniculi* Clark, which inhabit ulcers in the neck. The peculiar *Cuterebra emasculator* Fitch, has received this suggestive name from the fact that it mutilates the generative organs of our squirrels.

A bot-fly (*Oestrus hominis* Gmelin, or *Dermatobia hominis* Goudot) is described from South America and Mexico as inhabiting wormholes in the human body, the parent fly having every facility for depositing the eggs in the naked bodies of the natives.

Foreigners, when bathing, are also attacked. It is not now believed that there is a special bot-fly of man, but the other species, chiefly those attacking cattle, dogs, horses, mules, etc., occasionally infest man. Their grubs have been found in the human scalp, nasal and ear cavities, and also in the stomach.

The occurrence of dipterous larvæ under the skin of man is more frequent in some countries than in others. In Norway, for instance, the larva of *Hypoderma bovis* is frequently found in such places. It is, however, not normal for these larvæ to exist there, and the situation is so unsuitable that they move about from place to place, resting from time to time long enough to produce an ulcer. Eventually, and generally in early larval life, they break through the skin and perish. Chiefly children from thirteen to fourteen years old are thus afflicted. Parents, to prevent this wandering of the maggot, press a ring over the swelling.

FAM. Tabanidæ (Horse-flies, Gad- or Breeze-flies).—These flies are distinguished by the perfect development of the trophi. The exerted proboscis in the female encloses six lancet-like instruments; in the male only four. The proboscis terminates in two fleshy, lip-like lobes, and is covered on the sides by the large, two-jointed maxillary palpi. Eyes very large, frequently beautifully colored; thorax thick and compact; scutellum large and elevated.

These flies are the terror of cattle, horses, and in some regions of man also. Only the females of *Tabanus* can torment our animals by means of their sharp lances: the males subsist upon the sweets of flowers. The many



FIG. 2996.—Larva of *Dermatobia Noxialis*. (From *American Naturalist*.)

species occurring in the United States frequent the neighborhood of marshes, and are most numerous in the prairies. During the hotter parts of the summer, and when the sun is shining brightly, thousands of them fly swiftly about, and frequently torment animals to such a degree as to kill them. Their larvæ, so far as known, are subterranean, or even subaquatic.

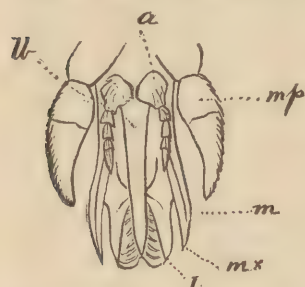


FIG. 2997.—Mouth-parts of *Tabanus*. *l*, Labrum; *m*, mandibles; *mx*, maxillæ; *mp*, maxillary palpi; *a*, basal joint of antennæ; *t*, tongue. (From *American Naturalist*.)

The "Green head" (*Tabanus lineola*), although one of the smaller species, has perhaps the worst reputation of our North American species. In parts of the Mississippi Valley it is impossible to work horses in midsummer without some protecting covering, and in more northern regions even cattle have to be covered. This is especially the case in Denmark, where native species are very tormenting. They often greatly annoy men, especially when bathing.

The Black Breeze-fly (*Tabanus atratus* Fab.) is very large, and though it does not attack horses to any considerable extent, is very troublesome to cattle. It is one of the largest species known, and easily recognized by its black color with a bluish-white bloom on the surface of the abdomen, and by its smoky dark-brown wings. The larva is a large twelve-jointed, cylindrical worm, tapering at each end, of a transparent, highly polished, glassy, yellowish or greenish appearance, with large roundish, retractile tubercles. It is found in moist soil near water

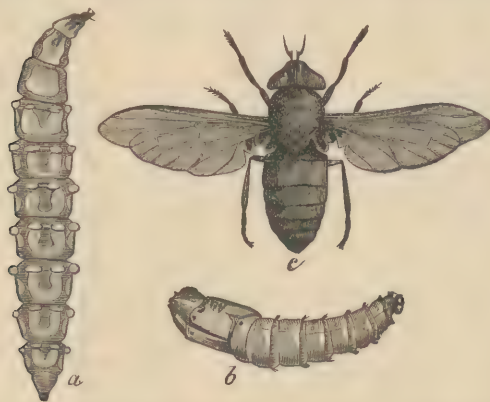


FIG. 2998.—*Tabanus atratus*. *a*, Larva; *b*, pupa; *c*, imago. (After Riley.)

or in the water itself, where it preys upon other animals, chiefly mollusks. The cylindrical, somewhat curved pupa is of a pale, semi-transparent, yellowish-brown color.

A related fly, the Tsetse-fly (*Glossina morsitans*), has a world-wide reputation. It is so dangerous that whole regions in Africa are uninhabitable during the season in which this insect abounds. Most animals suffer from its attacks, often dying from the effect, but goats, asses, sucking calves, some wild animals, and man are said to enjoy immunity.

Bruce, in his travels in Africa to discover the source of the river Nile, first figured, in 1790, this insect in "Select Specimens of Natural History Collected in Travels to Discover the Source of the Nile," etc. He gives a very interesting account of its mode of life, and a still more interesting historical sketch of the changes produced by it in the political history of the country where it occurs.

SUB-ORDER NEMOCERA (TIPULIDS, ETC.).—Antennæ composed of more than six joints, usually filiform in the females, plumose in the males; palpi four- or five-jointed;

pupa incomplete in Culicidæ and Tipulidæ, complete in Simuliidæ.

FAM. Simuliidæ (BUFFALO GNATS, BLACK-FLIES).—Antennæ eleven-jointed; trophi fully developed, biting; no ocelli; larvæ and pupæ aquatic; metamorphosis complete.

These well-known tormentors are almost as bad as the African tsetse fly just mentioned. In the north the black-flies are a very formidable pest, and at times almost prevent travel. They force the Labrador fishermen to spend their summers, very much against their will, on the seaside, as life in the interior is intolerable.

A. S. Packard, in "Our Common Insects," relates his experience in these words: "During a summer residence on this coast, we sailed up the Esquimaux River for six or eight miles, spending a few hours at a house situated on the bank. The day was warm and but little wind blowing, and the swarms of black flies were absolutely terrific. In vain we frantically waved our net among them, allured by some rare moth; after making a few desperate charges in the face of the thronging pests, we had to retire to the house, where the windows actually swarmed with them; but here they would fly in our faces, crawl under one's clothes, where they even remain and bite in the night. The children in the house were sickly and worn by their unceasing torments; and the shaggy Newfoundland dogs, whose thick coats would seem to be proof against their bites, ran from their shelter beneath the bench and dashed into the river, their only retreat. In cloudy weather, unlike the mosquito, the black fly disappears, only flying when the sun shines. The bite of the black fly is often severe, the creature leaving a large clot of blood to mark the scene of its surgical triumphs."

The Buffalo Gnats of the South are also a very serious pest to the inhabitants of the lower Mississippi Valley; for, although they do not usually greatly torment man, his cattle, horses, mules, sheep, and even his fowls, suffer terribly, and large numbers of them succumb every season.

The Buffalo Gnat (*Simulium meridionale* Riley) is the best known and largest of the species. It occurs in all the lowland of the valley, extending from the latitude of St. Louis to the northern portion of Louisiana, and east and west along the larger tributaries of the Mississippi River. It appears in swarms nearly every spring, earlier or later, with the inundations, and causes immense losses to the domestic animals. Only the females possess mouth organs adapted to biting. Appearing in immense numbers, they gorge themselves with blood, and this loss of blood, with the terrible irritation of the skin by so many poisonous bites, is sufficient to kill, in a very short time, all but the strongest of the attacked animals. Smoking and greasing is of very little help if the flies are very numerous. Dark stables are the only protection to the stock.

The very peculiar larvæ live in the strongest currents of the creeks and bayous, feeding there, no doubt, upon lower aquatic animals. The peculiar fans on their head, which are in constant motion, serve to create currents of water and thus to draw the food toward the mouth. The pupæ, neatly enclosed in a partially open cradle, are also very peculiar. Instead of having, like the larvæ, breathing organs on the posterior end of the body, they have them upon each shoulder. These organs are composed of forty-eight fine threads closed at the end, and which unite near the base in a stout trunk communicating with



FIG. 2999.—*Simulium Pecuarum*. Larva. (After Riley.)



FIG. 3000.—*Simulium Pecuarum*. Pupa. (After Riley.)

the interior tracheal system. The eggs are laid close to the edge of the water, usually upon the trunks of trees, and hatch soon afterward.

FAM. *Culicidae* (Mosquitoes).—The family is characterized by having the mouth produced into a slender rostrum, which is about half as long as the entire insect and slightly thickened at tip. The slender antennæ are plumose in the males, pilose in the females. Larvæ and pupæ aquatic; metamorphosis complete.

The mosquito, at least the female, is so well known that it is hardly necessary to describe it. Fig. 3302 represents *Culex pipiens* and its larva and pupa. Numerous species of mosquitoes occur over the whole of the world. They are troublesome in the torrid as well as in the arctic zone, preferring, however, regions with extensive fresh-water and brackish swamps. As stated in our "Little Known Facts about Well-known Animals," they have caused the rout of armies and the desertion of cities, and the hum of an insignificant gnat may inspire more terror than the roar of the lion. The bravest man on the fleetest horse dare not cross some of the more rank and dank prairies of Northern Minnesota in June. It is well known that Father De Smit once nearly died from mosquito bites, his flesh being so swollen around the arms and legs that it literally burst. Those who have travelled in summer on the lower Mississippi or in the Northwest, have experienced the torment which these frail flies can inflict; at times they drive everyone from the boat, and trains can sometimes only run with comfort on the Northern Pacific by

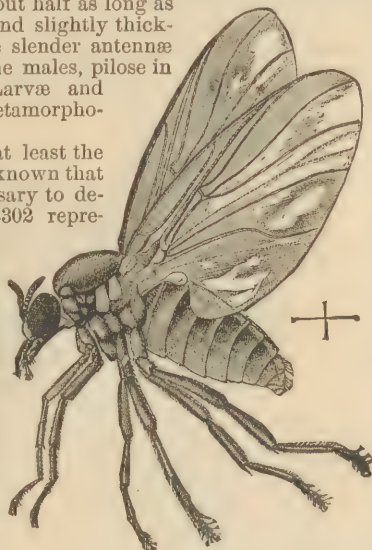


FIG. 3301.—*Simulium Pecuarum*, Female Fly. (After Riley.)

to come to the surface of the water. This habit can be utilized to kill all the wrigglers by means of a very little oil, which spreads over the surface of the water and effectually kills them. After throwing off the skin a few times, the larva changes into a pupa (Fig. 3002, *g*), which breathes by means of tubes upon its back. In this state they are no longer able to do anything but patiently float with their humped backs at the surface of the water, or to swim by jerks of the tail beneath. At the end of about three days they stretch out on the surface like a boat, the mosquito bursts the skin, and gradually works out of the shell which supports her during the critical operation. She rests with her long legs on the surface for a few moments, till the wings have expanded and become dry, and then flits away. The larvæ of the mosquito are great scavengers in infancy, by purifying the water; they perform in this way an indirect service to man, which few, perhaps, appreciate, but which somewhat atones for their bad habits in maturity.

The rounded head of the mosquito has two eyes, almost meeting on the top. Two long, delicate, hairy antennæ (*a*), quite different in the two sexes, start from the forehead. Just below arises the long beak, which consists of the bristle-like maxillæ, *mx*, with their palpi, *mp*, and mandibles, *m*, and the compound hair-like la-

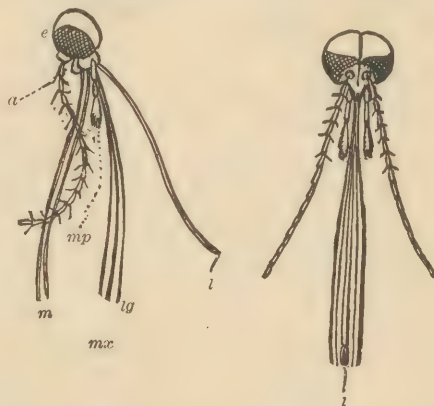


FIG. 3003.—Mouth-parts of Female Mosquito, Front and Side View. *a*, Antennæ; *mx*, maxillæ; *mp*, maxillary palpi; *m*, mandibles; *l*, labrum; *e*, eyes. (After Packard.)

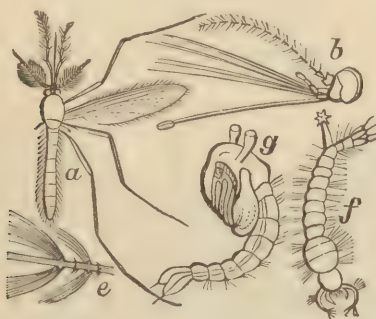


FIG. 3002.—*Culex Pipiens*. *a*, Male; *b*, head of female; *e*, joints of male antenna; *f*, larva; *g*, pupa. All enlarged. (After Westwood.)

keeping a smudge in the baggage car and the doors of all the coaches open to the fumes."

The young larvæ hatch from eggs deposited upon any stagnant water; the female, in depositing them, supports herself on the water with her four front legs, crossing the hinder pair like the letter X. The minute eggs, just perceptible to the naked eye, are glued together so as to form a little boat, which floats about till the young hatch. These young wrigglers or wriggle-tails can be seen in every tub of rain-water that has stood uncovered for a week during any of the summer months. The full-grown larva (Fig. 3002, *f*) breathes by means of a tube at its posterior end, and to do so has

brum-epipharynx, *lr*; these five bristle-like organs can be laid together and are hidden in the hollowed labium, *l*. Massed together into a single, awl-like beak, they are all, excepting the labium, thrust into the flesh.

The irritation and subsequent swelling is not simply made by the tearing of the mouth-parts in the skin of the victim, but by a poisonous saliva, which is very probably injected through a duct in the hypopharynx. At least no irritation is produced, even in very sensitive parts of the skin, when the insect fails to strike blood.

SUB-ORDER APHANIPTERA (FLEAS).—Body compressed laterally, with separated thoracic segments; no wings, but instead two scaly plates on the sides, those on the metathorax being largest; antennæ very short. Mouth formed for suction; mandibles and lingua long and setiform; maxillæ small, triangular scales with four-jointed palpi; labium minute, with three-jointed palpi. Larva vermiform, pupa inactive.

Fleas are wingless flies. The fleas which torment man (*Pulex irritans*) are less common in bedrooms in this country than in Europe; but other species are often extremely troublesome out-doors, especially in sandy soils in the Mississippi Valley and in Southern California. The shape of the flea is well known to most people, for even where no personal annoyance has been experienced, a pet, a dog or cat, will be apt to introduce it to notice. The body of the flea is much compressed, and there are minute wing-pads, instead of wings, present in some species. The legs are very powerful, enabling the flea to jump enormous distances measured by its size. The

larvæ of fleas are long, cylindrical, and white; they are composed of thirteen segments, exclusive of the head, and are provided with rather long hairs. The larva is very active in all its movements, feeding on dry blood and other animal matter, such as dead flies, which are frequently found on the unswept floors of outhouses or in the bed-straw of the animals they infest. It requires but a short time to mature a brood of fleas in warm weather; they remain about six days in the egg, a few days in the larva, and about ten days in the pupa, state.

The different species of fleas inhabiting northern countries may be at times very troublesome, but are trifling compared with their tropical relative, the sand flea, alias jigger, chigoe, chique, biche, or pique (*Sarcopsylla penetrans* L.). This flea is very commonly found in sandy places along the rivers of South America, and prefers the vicinity of old camping grounds of the Indians.

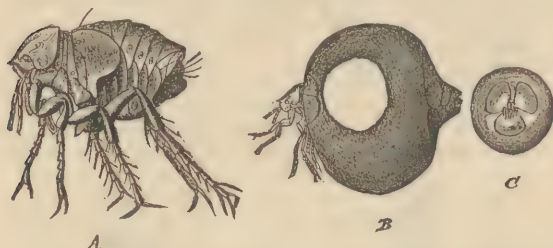


FIG. 3004.—*Sarcopsylla Penetrans*. A. Female, before entering host. B. Female, several days after entering host. C. Front view of swollen female. (After Karsten.)

Both sexes imbibe blood freely, the bite being very irritating, and often producing large swellings. The female penetrates under the nails, especially of the toes, where her abdomen swells to about the size of a pea. Here about sixty eggs are deposited in a sort of sac, and the young hatch and feed upon the swollen body of their mother until they are full grown, when they escape to the ground.

The natives, not wearing shoes, have their feet much hardened, and seem not to mind these intruders, which produce no especial pain in penetrating. If once under the nail, and not disturbed, no serious consequences take place; but if in removing the swollen skin of the flea it is ruptured, distressing sores frequently result.

ORDER LEPIDOPTERA (BUTTERFLIES, MOTHS).—Characterized by having four branching-veined, membranous wings, each more or less densely covered on both sides with minute imbricated scales which are attached by a stalk, but which easily rub off, and appear to the unaided eye like minute particles of glistening dust or powder. Transformation complete.

The insects of this order, in their mature or winged state, are all non-poisonous, and it were unnecessary to mention them here, did not some of their caterpillars or larvæ possess urticating and poisonous qualities.

In most species the irritation produced is of a mechanical nature, but in others there is a truly poisonous quality. Some of the large horn-tailed larvæ of the *Sphingidæ* (Hawk-moths) have acquired a reputation, in the popular mind, for being poisonous, e.g., the common green tomato-worm (*Macrosila 5-maculata*). There is not a particle of foundation for such belief, as none of these sphinx-worms can penetrate the skin, and the brown juice dropped from their mouth, when roughly handled, is perfectly harmless.

The caterpillars which possess poisonous and urticating propensities belong, for the most part, to three families: (1) the Bombycidæ, or spinners, which have, as a rule, long hairs and spin a cocoon; (2) the Saturniidæ, which are spinous rather than hairy; and (3) the Conchilipodidæ, or slug-worms, which have both spinous and hairy representatives, and which are characterized by the flattened venter and short legs, which induce a slug-like locomotion. In the first category the source of irritation is either a powder secreted from the general surface, or

the hairs, both of which are mixed with the cocoon. In the second, it is a poisonous quality of the spines themselves; and in the third, the evidence seems to point to a secreted poison injected through the spines as instruments.

The Processionary caterpillars of the oak (*Cnethocampa processionæ*), and other related species on the pine, are greatly feared in Europe, and not without cause. The whole external surface of the skin secretes an acrid juice, which dries over the body in a farinaceous form, and



FIG. 3005.—*Saturnia Io*. Male moth, natural size. (After Riley.)

which produces acute irritation upon contact, especially with the more delicate surfaces, through inhalation. Workmen who are occupied in woods where this caterpillar is numerous, have been known to sicken rapidly from this cause. The long hairs, under the microscope, are seen to be branched, and are said to be filled with a form of formic acid. When broken off in the human skin, they produce a terrible itching and burning sensation. There are many cases on record, where such hairs have found their way by some means to the interior organs of people or animals, producing dangerous inflammation, resulting even in death. Cattle, which like to rub themselves against trees, sometimes come in contact with the cast-off skins of these caterpillars, and become perfectly frantic.

In Brazil, a species, probably yet without a name, or which we have not yet determined, acts in very much the same way, but produces greater irritation and pain. Mr. Albert Koebele, who did some collecting for us there in 1883, found the irritation almost intolerable, and that there was no escape from it so long as the larvæ, dead or living, or the cocoons, were anywhere in the neighborhood. This caterpillar is nearly three inches long, entirely black with white stigmata; each segment is armed with eight long, bright orange-yellow, very stout spines, which



FIG. 3006.—*Saturnia Io*. Female moth, natural size. (After Riley.)

divide at the very base, and toward their tips into numerous smaller bristles which point in every direction, thus protecting the entire surface of the caterpillar.

Here, in the United States, we happily have no caterpillars quite so dangerous, but there are a number which possess more or less severe urticating power and which produce severe pain. The caterpillars of *Saturnia Io* and *Hemileuca maria* are among the largest. The poisonous

quality in these cases seems to rest in the composition and structure of the spines themselves, rather than in any secretion connected with them.

The Io Moth (*Hyperchiria Io*) is one of our most beautiful moths, receiving its name from two conspicuous eye-spots on the hind wings, in allusion to the ancient Greek heroine, Io, who, as the fable went, was jealously guarded by the hundred-eyed Argus. The sexes differ remarkably in coloration. The smaller, male, is much brighter colored, being of a deep yellow, marked with purple-brown, the body and hind wings being of a deeper ochre-yellow. In the female, the purple-brown color pre-



FIG. 3007.—*Hyperchiria Io*. Larva, natural size. (After Riley.)

dominates, and she is somewhat differently marked. The cream-white eggs, with a small black spot on the apical end, are deposited in clusters on the underside of various leaves, such as willow, poplar, and others. The full-grown caterpillar is of a green color, with the longitudinal stripes at the sides white and lilac-red. In our experience the urticating properties of this larva, which exist from the first stage, are keener than in *maia*. At all events it cannot be handled with the same impunity; for it has fewer of the bristle-ending spines, and more of the stout and acute spines which prick most readily. Dr. Geo. Dimmock published an account of certain protrusile organs of this larva in "Psyche," vol. iii., p. 352. They are found on the fourth and tenth segment, a trifle below the level of the stigmata. When retracted they look like an irregular opening, about half a millimetre in diameter; if the larva is irritated, these openings will be seen to evaginate and to re-invaginate alternately. These organs are probably the openings of glands, and may be used to drive away some parasites, but are not connected, it seems, with any urticating powers of the caterpillar.

The Buck Moth (*Hemileuca maia*) is a truly elegant moth, which flies in midday late in October and November. The color of its wings is that of crape, banded with cream-white; its body is of the same black color, but is sprinkled with white, and has a cream-white collar; the male has a large tuft of brick-red hair at the tip of the abdomen. The pale greenish-cream eggs are deposited in naked, somewhat spiral, belts of from one hundred to two hundred around small twigs of oak. The caterpillar produced from them is brownish-black, covered with more or less conspicuous small oval, yellow elevations or papillæ, with a lateral yellow stripe formed by the confluence of some of the papillæ and by broken, irregular yellow marks.

The Conchliopodidæ contain more urticating larvæ

than any other family or group of Lepidoptera, the stinging property resting in the more minute, short, and soft spines, which either beset the larger spines or lie close to the body, hidden at times by soft and harmless hair.

The common "Saddle-back," a characteristic brown larva with a green "saddle," and producing a rich-brown moth (*Empretia stimulea* Cl.), will serve as an illustration of the former; and the equally characteristic larva of a woolly, cream-white moth (*Lagoa opercularis* Harr.), with its long soft hair under which



FIG. 3009.—*Empretia Stimulea*. Natural size. (After Riley.)

are hidden the bunches of short stinging spines, is typical of the latter. In the tropics some related species attain large size, and are much dreaded by the natives.

A few Noctuidæ possess in the larva state this stinging property in diminished degree—especially in the genus *Acronycta*, as we have shown in *A. xyliniformis*, and under exceptional circumstances, all hairs or spines that are barbed may produce more or less inflammation.

ORDER COLEOPTERA (BEETLES).—Characterized by having four wings, the front pair horny or leathery, and usually united down the back with a straight suture when at rest, the hind ones membranous and folded up under the elytra when at rest. Transformations complete.

None of the insects of this Order are known to have poisonous bites. The larger specimens, by means of powerful, hard mandibles, can bite severely, but no poison is secreted, and only a momentary pain without subsequent inflammation is the result. But quite a number of beetles possess chemical properties, which may, under certain conditions, blister or poison persons who handle them carelessly.

Among the *Carabidæ* or ground-beetles, the bombard-ing-beetles (genus *Brachynus*) have a peculiar method of defence from their enemies. They eject from the posterior part of the body an acrid gas or vapor which, when condensed, becomes a yellowish-red fluid which is strongly acid, as shown by the litmus-paper test.

Some other *Carabidæ* also secrete a rather poisonous fluid, which issues from their mouth; some of the *Chrysomelidæ*, upon being disturbed, produce drops of a nasty,

sometimes pungent, fluid, while some of the large water-beetles (*Dytiscidæ*) secrete a very offensive-smelling liquid, which is ejected at the moment of danger. But the only truly poisonous beetles are the vesicants belonging to the family *Meloidæ*.

The Spanish fly (*Cantharis vesicatoria* L.) is well known to every physician. It occurs everywhere in the temperate regions of Europe; its life-history is as yet not completely known, though the larva has been artificially fed by Lichtenstein on honey and bee-bread; and the



FIG. 3010.—*Macrobasia Unicornicolor*. Male, natural size. b, Beetle; c, enlarged male antenna. (After Riley.)

presumption is that it is parasitic in the cells of certain mason-bees. We have numerous species of blister-beetles in this country, and chiefly on our western plains, where their larvæ, as we have shown, feed upon the eggs of locusts.

This habit was suspected by us in 1876, and was first demonstrated in 1877. All blister-beetles are elongate in form, and possess the property of drawing blisters on human flesh. Many of the species show great partial-

ity to the potato, and were for a long time considered the most formidable enemies of this esculent. Careful examination of locust eggs in the vicinity of potato-fields frequented by these beetles, show a varying proportion of the egg-pods affected, and in some locations

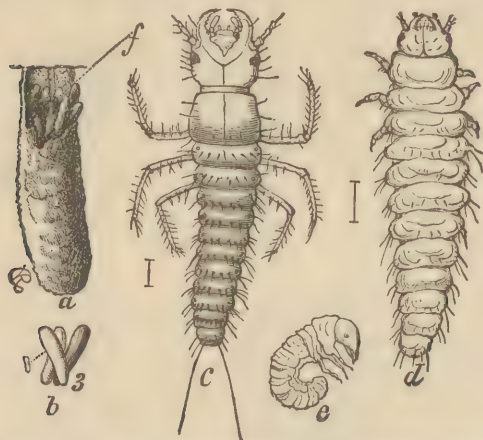


FIG. 3011.—a, Egg-pod of *Caloptenus differentialis*, with the mouth torn open, exposing the newly-hatched larva of *Epicauta vittata* eating into an egg—natural size; b, eggs of *E. vittata*, the natural size indicated at side; c, dorsal view of the first larva, or triungulin of *E. vittata*, greatly enlarged; d, dorsal view of second larva of *E. vittata*; e, side view of the second larva, showing its natural position within the locust-egg mass. (After Riley.)

nearly every pod of the differential locust (*Caloptenus differentialis*) will contain the blister-beetle larva. The eggs of this locust are laid in large masses of seventy to about one hundred. From July to the middle of October the eggs of the beetles are laid in the ground in loose,

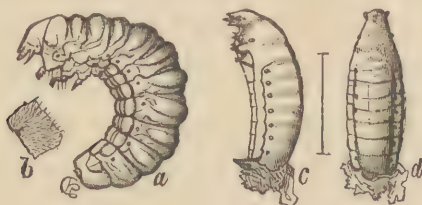


FIG. 3012.—a, Lateral View of the Ultimate or Full-grown Stage of the Second Larva of *E. vittata*; b, portion of the dorsal skin, showing short setaceous hairs; c, lateral view of the pseudo-pupa or Coarctate Larva of *E. vittata*, with the partially shed skin adhering behind; d, dorsal view of same. (After Riley.)

irregular masses, the female excavating a hole for the purpose. In the course of about ten days the larva, or triungulin, hatches. This triungulin is at first feeble and perfectly white, but soon assumes a light-brown color and commences to move about very rapidly, prying, with its large head and strong jaws, into every crease and crevice in the soil,

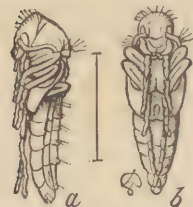


FIG. 3013.—a, Lateral View of the True Pupa of *Epicauta cinerea*; b, ventral view of same. (After Riley.)

After feeding for about another week, a second molt takes place; the modification at this molt is slight, but the mouth-parts and legs become rudimentary. Another six or seven days elapse, and another molt takes place, without producing any material change, except in size. In

another week it forsakes the remnants of the egg-mass, and burrows a short distance in the clean soil, where it forms a smooth cavity within which it lies stretched on one side, motionless and gradually contracting. The skin separates and becomes loose at the end of the third or fourth day, when it splits on the top of the head and thoracic joints and is worked toward the extremity, but never fully shed. The mouth-parts and legs are now quite rudimentary and tuberculous, the soft skin rapidly becomes rigid and of a deeper yellow color, and we have now a pseudo-pupa. In spring this skin is rent on the top of the head and thorax, and from it crawls the third larva, which differs in no respect from the ultimate stage of the second larva already mentioned, except in the somewhat reduced size and greater whiteness. This third larva is rather active, and burrows about in the ground. In a few days it changes to a true pupa, and after a rest of five or six days the winged form is assumed.

ORDER HYMENOPTERA (BEES, WASPS, ETC.).—Characterized by having four membranous wings with comparatively few veins, the hind pair smallest; mouth-parts fitted for either biting or sucking (licking); a compact and consolidated pro-thorax. Metamorphosis complete.

The most aggressive and venomous insects are found in this order. The sting is the chief weapon of defence. It is always either the female or the so-called neuter which possess the sting, which is in fact but a modified ovipositor; the males never have it.

In the *Terebrantia*, in which the females possess a long, exerted ovipositor, the parasitic species may be briefly referred to, since some of the species, although usually small and weak, can sting and occasion considerable pain. Their normal habit is to use the sting as an ovipositor, by means of which they insert their eggs into, or on, or near various phytophagous larvae. The species of the genus *Ophion* occasionally sting persons who handle them, and produce a violent but transient pain.

It is among the *Aculeata*, however, the highest organized of insects, that we find the most perfect stinging apparatus connected with a poison-gland.

The well-known and almost omnipresent ants (*Formicidae*) need no special description. Both females and workers (the latter simply sexually dwarfed females) possess stings with poison glands. Some of our native species both bite* and sting readily, and occasion violent pain. But in the tropics ants reach their maximum size, and are not only very numerous but also very aggressive. They sometimes attack man and beast with blind fury, inflicting severe pain, and even causing death when in great numbers.

The so-called cow-killers (family *Mutillidae*) are brightly colored, usually brilliant red, insects, and look in their unwinged forms very much like stout, hairy ants. They are very poisonous. The sting is almost as long as the body, and some of the species are very aggressive. Unlike the social ants, they are usually found running about singly in open fields, in sandy places, and during the hottest part of the day. They are very bold and seem conscious of their power to withstand the attack of larger animals, for the body-wall is so hard and tough that it is difficult to crush. The sting produces violent inflammation, fever, and lameness, and as the popular name indicates, cows are supposed to be killed by it in Texas.

The fossorial or digger-wasps (family *Sphegidae*) have all a more or less poisonous sting. Their usual mode of life is such that they need such a weapon. Although living in their winged state upon pollen and honey of plants, their young must be fed with fresh flesh. The mother wasp, having prepared a cell in the ground or elsewhere, or having built one from clay or other material, selects a spider, worm, fly, beetle, or other insects that are suitable (and each species has its own peculiar taste in this matter), and stings its victim just enough to paralyze it, when it is carried to the prepared cell, an egg deposited upon or near it, and the cell closed. The egg in time hatches, and the wasp larva feeds upon the liv-

* Many ants possess no stings, but they can inflict poisonous bites with their mandibles, injecting formic acid in the wound.

ing, yet helpless, food, thus carefully provided by its parent.

Some of our largest wasps belong to this family. In the Middle or Southern States the large digger-wasp



FIG. 3014.—Digger-wasp (*Stizus Grandis*). (After Riley.)

(*Stizus grandis*) is a rather common feature. This wasp stores its nest with cicadas, often much larger than the wasp itself. Any one who has heard the cries of agony of a cicada stung by this wasp will never forget it. Two or more stings inflicted by this insect at the same time upon man might readily endanger his life. The bite of a scorpion is not more dangerous, and it is fortunate that these wasps are not aggressive. Strong, active, and rapid in their motion, clad in a bright and well-fitting uniform, with keen senses, and armed with terrible weapons for offence and defence, they would be dangerous indeed if they normally attacked man. Entomologists, although accustomed to capture all kinds of poison-



FIG. 3015.—Blue Digger-wasp (*Chlorion Caerulium*). (After Riley.)



FIG. 3016.—*Pepsis Formosa*. (After Riley.)

ous wasps without fear, hesitate to try their net upon this species.

Other larger and brilliantly colored species occur everywhere in the United States. The common Blue Digger-wasp (*Chlorion caerulium* Drury) is frequently found fly-

ing about houses in quest of spiders, with which it provisions its nest in the earth. The hole in the soil, previously made for the reception of a spider, is so carefully hidden after being filled with the victim, that without having marked the exact place it would be impossible to detect it.

The Ichneumon-like Digger-wasp (*Sphex ichneumonea* L.) is more common in the Northern States, and occurs more frequently upon flowers. It fills its nest with the young of our common grass-green meadow katydid.

Another gigantic digger-wasp (*Pepsis formosa* Say) has the useful habit of stinging the poisonous tarantula of Texas in such a way as to render it entirely defenceless; it is then carried to a hole in the ground prepared beforehand, and consumed by the soft larva of the



FIG. 3017.—*Pelopaeus Lunatus*. (After Riley.)

Pepsis, which is hatched from an egg laid by the female before closing the nest. On account of this habit it is called in Texas the "tarantula killer."

The mud-daubers are well known to most people. Our common *Pelopaeus lunatus* Fab., is often found in out-buildings, where it constructs a nest of tempered clay, affixing it to the interior walls or to overhanging cliffs. In search of moist clay for this purpose, it may often be seen, during a long dry spell of summer weather, perched on the ground in the neighborhood of wells and other



FIG. 3018.—*Vespa maculata*. (After Riley.)

wet places. The mud-dabs are composed of one or more layers or tiers of clay tubes, arranged side by side and cemented on to some surface well protected from the weather. The cells are provisioned with spiders, which form the food for the one maggot bred in each cell.

The paper wasps (family *Vespidae*) are familiar to all, and most people have been convinced by actual experience that their sting is poisonous and quite painful. Members of this family lead a similar mode of life to that of the digger-wasps. They live also upon pollen, honey, and the juices of fruit; but their young require animal food, which is brought them by the workers or by the females themselves. The sting with which they are provided is therefore not used to procure and prepare the food, but to defend themselves,



FIG. 3019.—*Polistes*. (After Riley.)

and to revenge some imaginary affront. It is not barbed, and may, therefore, be used repeatedly.

The Bald-faced Hornet (*Vespa maculata* L.) may be taken as a familiar example of the habits of this group. Their nests, made of sheets of strong, gray, weather-proof paper, are suspended from the branches of trees, and some of them when completed are much larger than a man's head. Each nest, whatever be its location, is suspended from some object above it by a single strong pillar. Inside, combs or layers of hexagonal cells are

placed, each suspended from above it by numerous little pillars of the same *papier-mâché* that the insect employs in all its architecture—thus leaving an open passageway between the different tiers. These combs, constructed of the same paper-like substance, and not, as in the case of the honey-bee, of wax, differ further from those of the honey-bee in their horizontal position, and in containing each of them but a single layer of hexagonal cells, with their mouths opening downward. The cells are used exclusively for rearing the larvæ.

The yellow-jackets, such as *Vespa vulgaris* and *V. germanica*, have similar habits. The more slender species of the genus *Polistes* build their combs in spots partially sheltered from the weather, but always without any paper envelope, and usually with but a single comb to a nest.

All wasps guard their nests with great care, and if any foreign body approaches all those upon the nest stand quite erect upon their legs, turn their heads toward the intruder, and make a humming noise with their rapidly vibrating wings. It is now time for the intruder to leave the spot; to touch the nest would give them the signal for attack. Hornets and wasps were well known to the Greek and Roman writers. Plautus repeatedly uses the expression "*Crabrones irritare*," perhaps thus indicating personal experiences. The impudence and rashness of both hornets and wasps are well known. They enter our rooms, creating terror, to obtain a fly, a spider, a bit of meat, or sugar and fruit, and do not in the least mind the persons present. They are very fond of ripe fruit, and do not wait, like honey-bees, until the skin of the coveted food breaks, but, using their jaws, they force their way to the juicy portions. The honest working-bee, which is attracted to this spread table, has usually to take all the blame. Wasps are always in a feverish haste, which is not to be wondered at, considering the large nests made by them in the course of one summer. During autumn we find, besides the workers, males and females. After pairing, and when the workers become old and weak, they are seized with a very peculiar frenzy; in blind fury they turn their murderous instincts against their own family, and the larvæ and pupæ, so well taken care of before, are now mercilessly torn from their cells and thrown to the ground to perish. All order ceases. The fertilized females escape and find suitable hibernating quarters in the ground, under moss or dead trees; all the rest succumb to the first frost.

The larvæ of all wasps are chiefly fed with animal food. Like a bird of prey, the hornet pounces upon its victim, throws it to the ground, cuts off legs and wings, and carries the still quivering insect to a branch of a tree, where all the soft parts are removed; after being chewed very fine, they are rolled into a ball and carried home to the nest. Arrived, the food is again chewed and cut into small pieces, which are laid upon the mouths of the helpless larvæ.



FIG. 3020.—Sting of Bee.
Enlarged. a, Tip of lancet, still more enlarged.
(After Gosse.)

FAM. *Apidæ* (Bees).—Most of the bees, though not so spiteful as the wasps, know perfectly well how to use their defensive weapon, and the pain inflicted by them is quite severe. Only the so-called workers have such stings. The good-natured bumble-bee, and the useful honey-bee, belong to this family. Many species lead a solitary life, others live in smaller or greater communities. The parents and their offspring feed upon pollen and honey.

The gigantic Carpenter Bee (*Xylocopa carolina* L.) is well known by its habit of boring numerous holes in such parts of timbers as are neither whitewashed nor painted. At the bottom of one of these holes, which are often many inches deep, they deposit

provisions consisting of pollen for their future larvæ. These bees also make holes in partially decayed wood, but wherever the bark covers the wood, there they refuse to bore. Carpenter bees are usually mistaken for large bumble-bees, though they are solitary and not social as the latter. Their polished abdomen, uncovered with any hair, distinguishes them at a glance from bumble-bees. Their sting is very painful, and they should not be interfered with when flying over porches. The best way to keep them away is by painting the woodwork.

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